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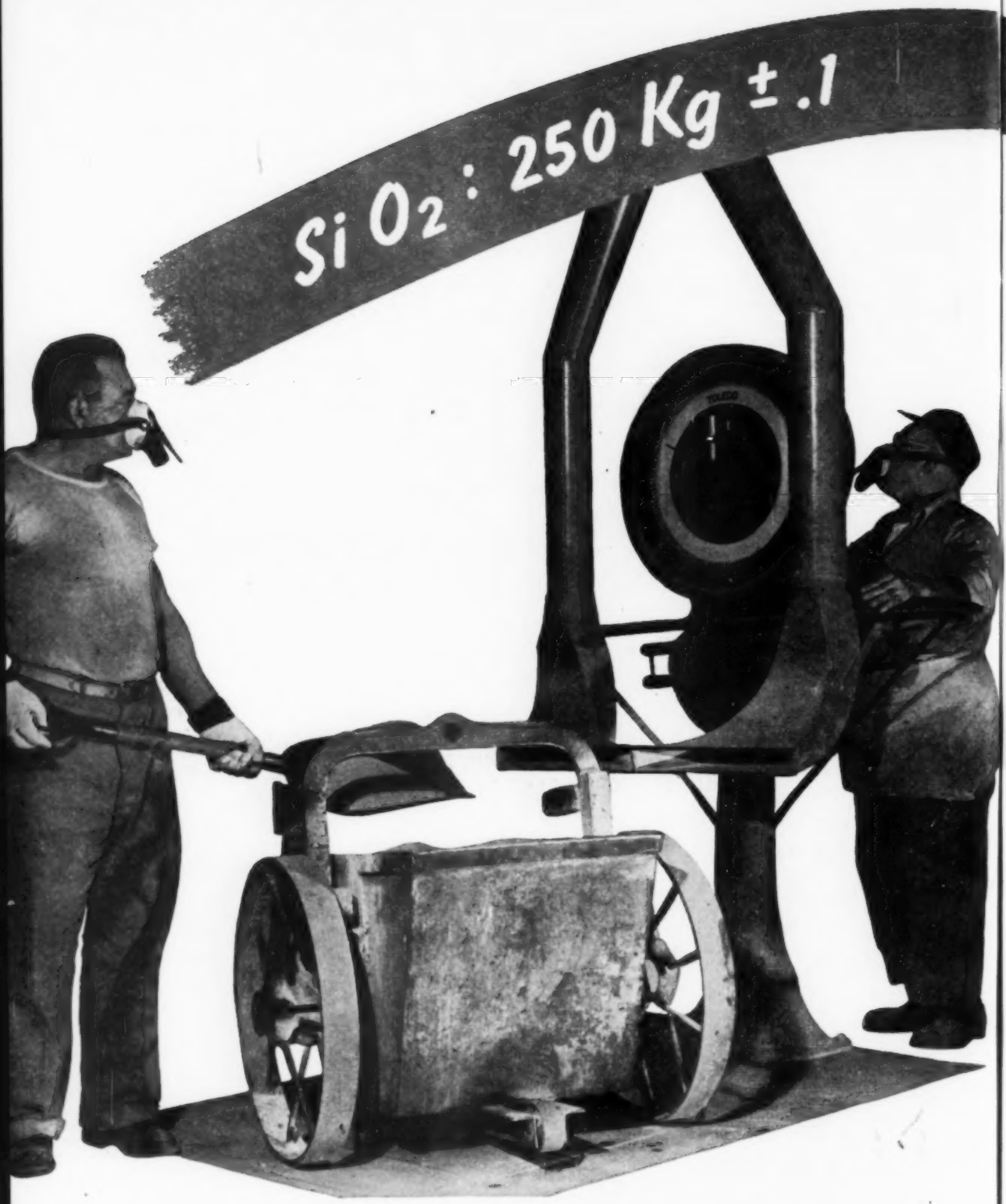

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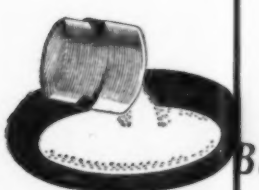

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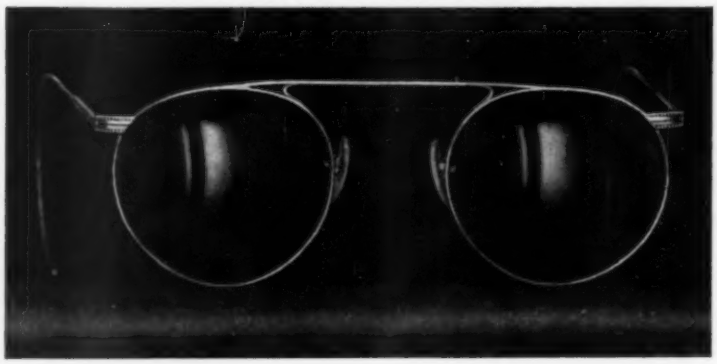

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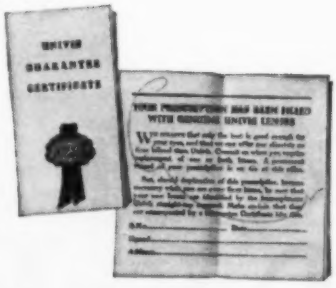

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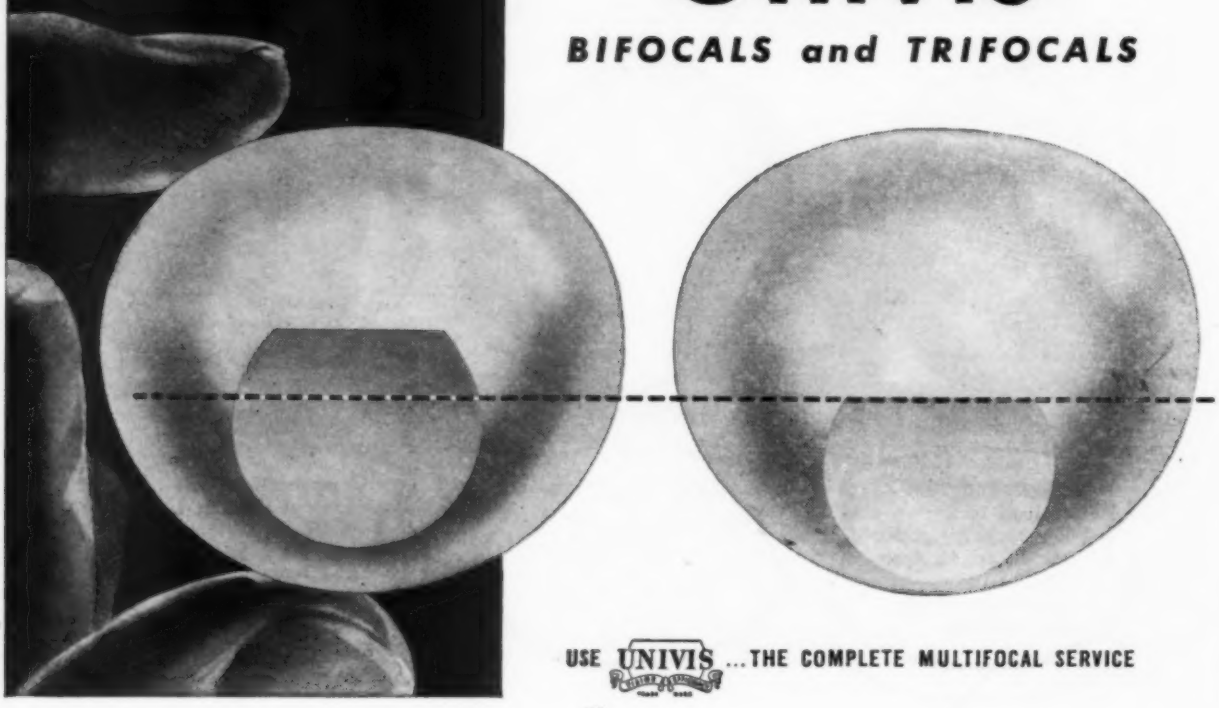

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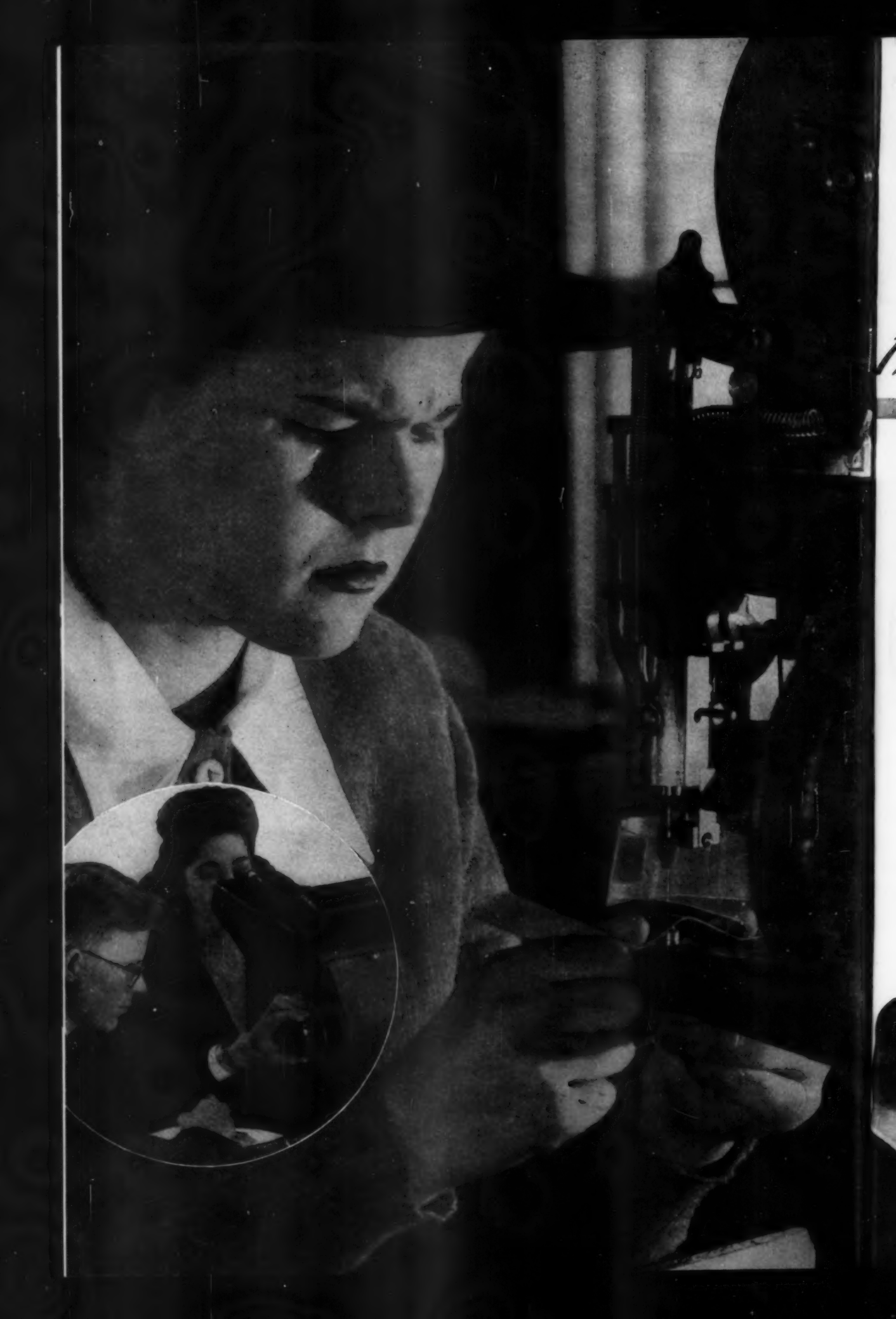

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EFFECT OF QUALITY OF ILLUMINATION AND DISTANCE OF OBSERVATION UPON PERFORMANCE IN THE ISHIHARA TEST*†

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Columbus, Ohio

PART I

INTRODUCTION

A number of the individuals who fail to read the Ishihara charts correctly are able to do so, (1) if the observing distance is increased to two or more meters or, (2) if the spectral distribution of the illuminating source is altered. The investigations to be described show that the two effects are inter-related, and it appears desirable therefore to consider them together.

The effect of varying the quality of illumination is not at all surprising, and this aspect of the problem has already been investigated by Hardy, Rand, and Rittler.[1] However, the effect of increasing the distance does not appear to be well known. Dr. J. M. Babcock, an optometrist of Portsmouth, Ohio, called this effect to the attention of the junior author in 1941. Since then it has been discovered that Miles and

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†Aided by a grant for research in Physiological Optics by the Bausch & Lomb Optical Company.

**Graduate of the School of Optometry and the College of Medicine at The Ohio State University. This investigation was carried out by the senior author while enrolled as a student in the College of Medicine and was done under the supervision and with the help of the junior author.

‡Director, School of Optometry, The Ohio State University, Columbus, Ohio. Optometrist. Fellow, American Academy of Optometry.

1. L. H. Hardy, G. Rand, and M. C. Rittler, The Effect of Quality of Illumination on the Results of the Ishihara Test. J.O.S.A., 36, 86-94 (1946).

Craig[2] observed and reported this effect in 1931, and Chapanis[3] has also made a study of it.

At the normal reading distance (40 cm.) the entire chart subtends an angle of about thirteen degrees at the eye. The character within the chart subtends an angle of approximately 8.5°. Moving the test chart to a distance of two meters reduces the visual angle subtended by the numeral to about 1.7°, and hence one effect of the increase in distance is confinement of the target to the rod-free area of the retina, which is about three degrees in diameter.

It was decided therefore to perform a systematic investigation of a series of normal and defective individuals to determine to what extent the distance of observation and the quality of illumination affect the performance rendered by different types of color-blind subjects and to determine the characteristics of central and paracentral vision which are responsible for these effects.

Thirteen subjects were used in the investigation.

Five of the subjects (1, 2, 3, 4, and 5) were regarded as normal because they were able to pass the Ishihara test and gave no other indications of abnormality.

Subjects who failed some or all of the Ishihara charts were classified as deuteranopic or deuteranomalous on the one hand, and protanopic or protanomalous on the other hand on the basis of luminosity data.

The deuteranopic (10) and protanopic (12 and 13) observers were segregated from the deuteranomalous (6, 7, 8, and 9) and protanomalous (11) on the ground that they were unable to distinguish green from a mixture of red and blue. These dichromats were able however to distinguish red from blue, and this proved that they were dichromats rather than total color blinds.

PART II

LUMINOSITY DATA

Apparatus and Procedure

Apparatus was provided for measuring relative luminance distribution curves for the fovea and for points 2° and 4° from the center of the fovea. The measurements were all made on the right eye while the left eye was occluded.

2. Alphonse Chapanis. Spectral Saturation and its Relation to Color-Vision J. 9, 437-449 (1931).

3. Alphonse Chapanis. Spectral Saturation and its Relation to Color-Vision Defects. J. of Exp. Psych., 34, 24-44 (1944).

The source of light (A in Fig. 1) was a 40-watt frosted light bulb. The source was broken into its spectral components by means of a diffraction grating (B). The target was square and subtended an angle of two degrees in each dimension. The photometer cube (E) had a silvered diagonal with a clear horizontal strip, and the top and bottom edges of this strip constituted the top and bottom edges of the test object. The sides were formed by the rectangular opening in the diaphragm (F). A square artificial pupil (K), 0.8 mm. on each side, was used to eliminate the effect of pupillary changes.

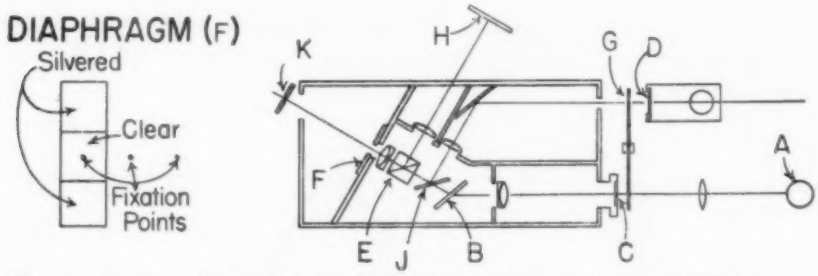

Fig. 1. Apparatus for measuring the relative luminance of spectral colors.

At wave lengths 10 mμ. apart the luminance of the spectral stimulus was made equal to that of a standard source (D) by varying the width of the slit (C) through which the light entered the instrument. The rotating sectored disk (G) and the plate of glass (J) provided a flicker photometer method for equating the spectral stimulus to the standard stimulus (D).

The luminance produced by the standard source was measured by using the photometer cube to compare it with the luminance of the surface, H. The luminance of H was varied to match that produced by D and then it was measured with a Macbeth Illuminometer and found to be 24 c/m.^{2} The aperture (H) was kept closed except during the making of this measurement.

The reciprocal of the slit width required to balance the spectral stimulus against the standard source (D) by flicker photometry gave a relative measurement of its luminance. In order that the luminance distribution curves for all subjects be made comparable, the reciprocal of the slit width for each wave length was multiplied by a factor to give the maximum ordinate of the distribution a value of one. No account was taken of the fact that an increased range of wave lengths was involved as the slit was widened, nor that the slit opened asymmetrically. Furthermore, no allowance was made for the transmission characteristics

of the instrument. Therefore the luminance distribution curve does not represent accurately the luminance distribution of the source. No attempt was made to measure the relative energies for the different parts of the spectrum, so that it was not possible to convert the data to luminosity values. However, variations in the luminosity curves are reflected in the luminance distribution curves, and hence variations in the luminosity curves for different individuals and variations from fovea to periphery can be deduced from the type of measurements made. The stray light in the instrument makes the data at the ends of the spectrum unreliable.

As shown in Fig. 1, three different fixation points were provided so that data could be obtained at the center of the fovea, and 2° and 4° from the center of the fovea.

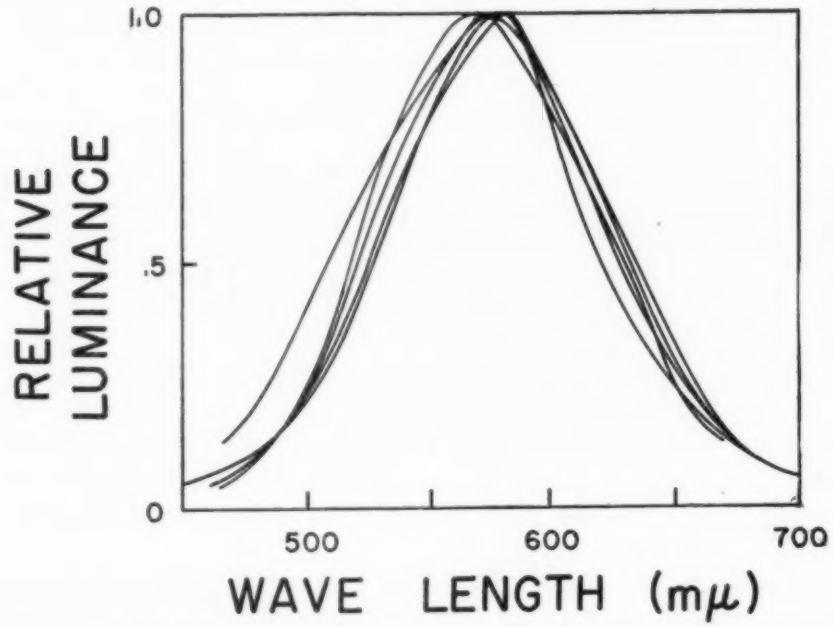

Fig. 2. Foveal luminance distribution curves for five normal subjects. The test field was square, subtending 2° at the eye. Flicker photometry was used to balance the spectral colors against a standard white (24 c/m²).

Luminosity Data for Central Vision

Fig. 2 shows the luminance distribution curves of five normal subjects for a square target, 2° on each side, fixated centrally in a dark field.

Fig. 3 gives the luminance distribution curves for four deutera-

nomalous individuals and one deuteranope, and for comparison the average luminance distribution curve for the five normal observers has been included. The curves for the deuteranopic and the deuteranomalous observers appear depressed on the blue side, but the depression is slight. The data of Pitt[4] for deuteranopes and the data of Pitt[4] and of Nelson[5] for deuteranomalous observers are fairly consistent in showing a slight shift of the whole luminosity curve toward red as compared with the normal. Judd[6] has pointed out, however, that these variations are within normal limits.

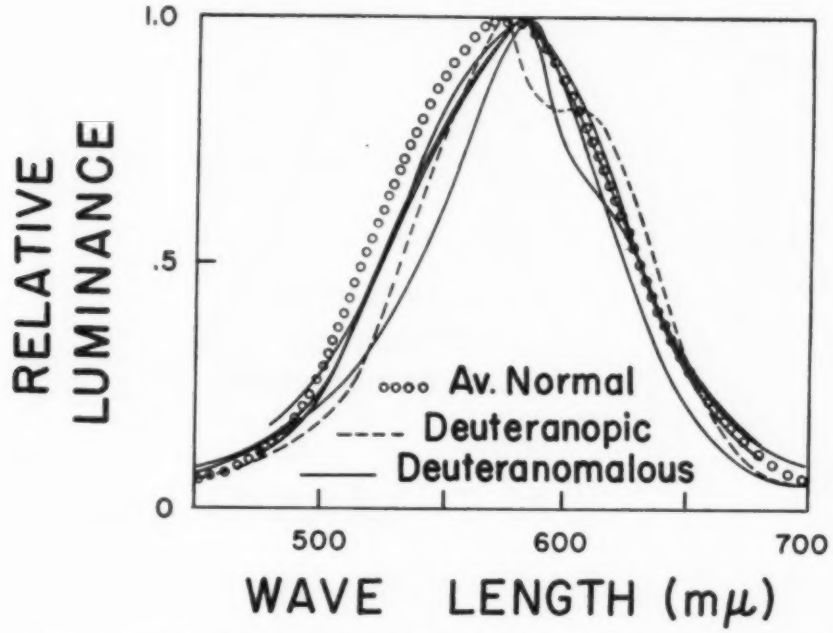

Fig. 3. Foveal luminance distribution curves for one deuteranopic and four deuteranomalous subjects. The average curve for five normal subjects is included for comparison.

Fig. 4 shows the luminance distribution curves for two protanopes and one protanomalous observer; and the average luminance distribution curve for the five normal observers has been included for comparison. The curves for Subjects 11 and 13 appear to be depressed on the red side as compared with the average curve for the normals. This

4. F. H. G. Pitt, Characteristics of Dichromatic Vision. Medical Research Council Special Report No. 200 (1935).
5. J. H. Nelson, Anomalous Trichromatism and its Relation to Normal Trichromatism. Proc. Phys. Soc. (London) 50, 661-702 (1938).
6. D. B. Judd, Facts of Color-Blindness, J.O.S.A., 33, 294-307 (1943).

agrees with the previous data of McKeon and Wright[7] for protanomalous individuals; but Pitt[4] found that the blue side of the protanopic curve is shifted slightly toward blue as well as depressed on the red side.

The curve for Subject 12 appears to be atypical in that the whole curve is shifted to the left. Further evidence that this case is atypical will be presented later.

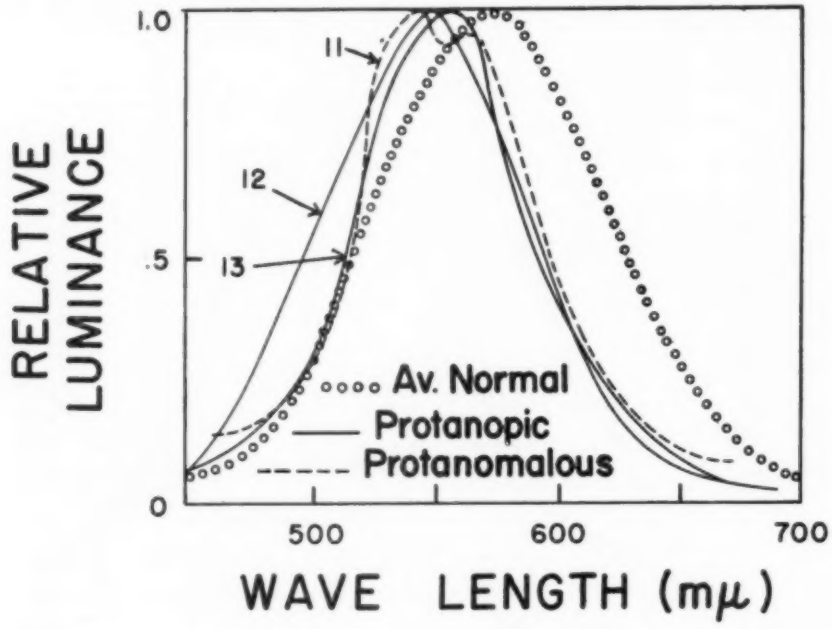

Fig. 4. Foveal luminance distribution curves for two protanopic and one protanomalous subject. The average curve for five normal subjects is included for comparison.

Peripheral Luminance Distribution Curves

In Figs. 5, 6, 7, and 8 are shown for all subjects except 2 and 6, the luminance distribution curves for a target 2° on each edge, observed centrally and with fixation points 2° and 4° from the center of the target. The normal, the deuteranopic and deuteranomalous observers show the same type of shift of the luminance distribution curve toward the blue end of the spectrum when the target moves away from central vision.

Subjects 11 and 13 have typical protanopic photopic curves for

7. W. M. McKeon and W. D. Wright, The Characteristics of Protanomalous Vision. Proc. Phys. Soc. (London) 52, 464 (1940).

the fovea, but in each case as the target moves away from the point of fixation the peak becomes broader and the curve shifts to the left and assumes the form of a typical scotopic curve for a normal observer.

In the case of Subject 12, the luminance distribution curve for the fovea and those in the periphery are practically identical and correspond to the typical scotopic curve of a normal subject.

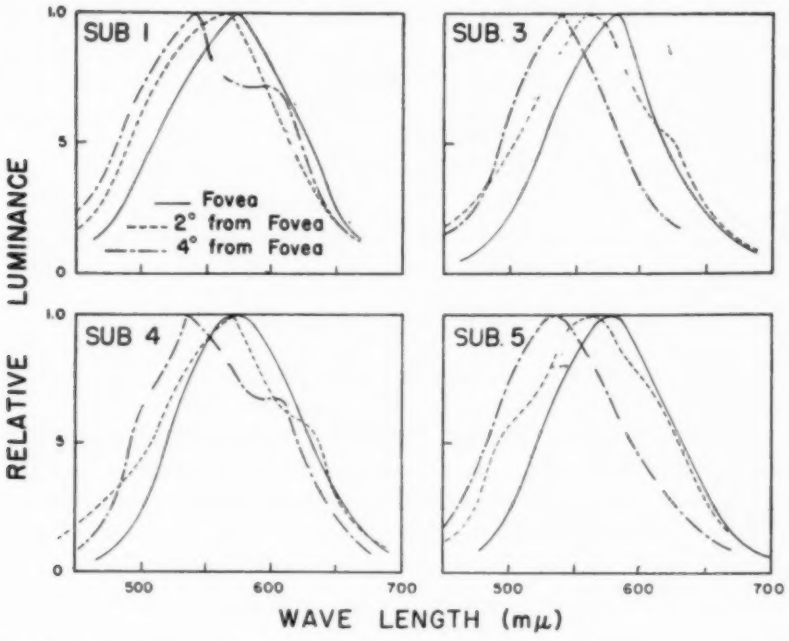

Fig. 5. Foveal and parafoveal luminance distribution curves for four normal subjects.

The Atypical Foveal Luminosity Curve of Subject 12

It has already been pointed out in the case of Subject 12 that the foveal luminosity curve more closely resembles the normal peripheral luminosity curve than a protanopic foveal luminosity curve, and that there is no appreciable difference between the central and peripheral luminosity curves. The other protanope (13) and the protanomalous observer (11) show the typical protanopic central luminosity curve, and the peak shifts toward the blue end of the spectrum when the curve is measured in the periphery. These facts indicate that the central luminosity curve of Subject 12 is dependent on the presence of rods in the fovea.

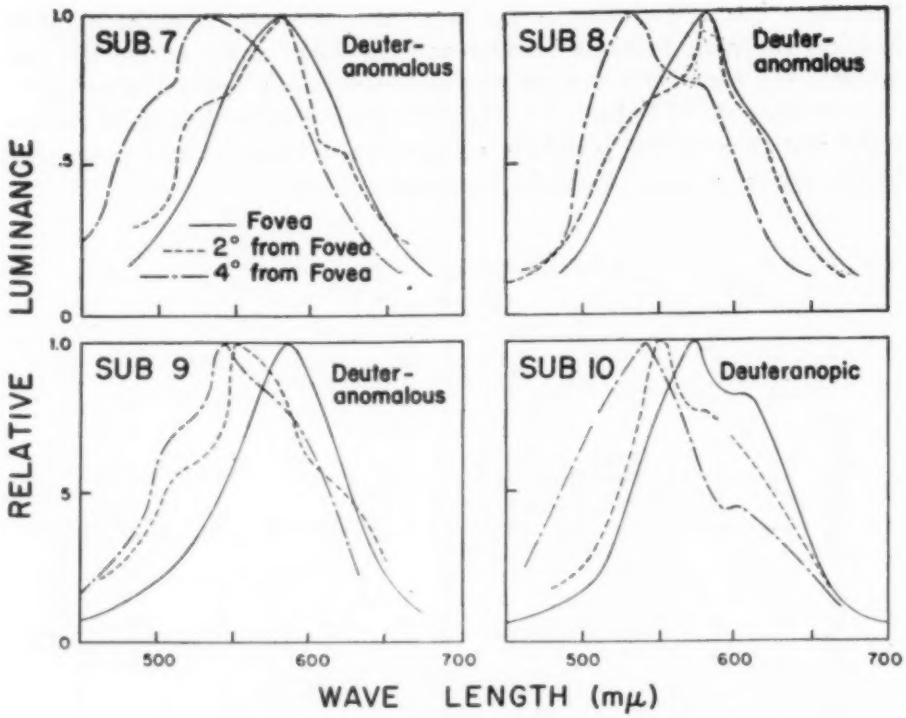

Fig. 6. Foveal and parafoveal luminance distribution curves for three deuteranomalous subjects and one deuteranope.

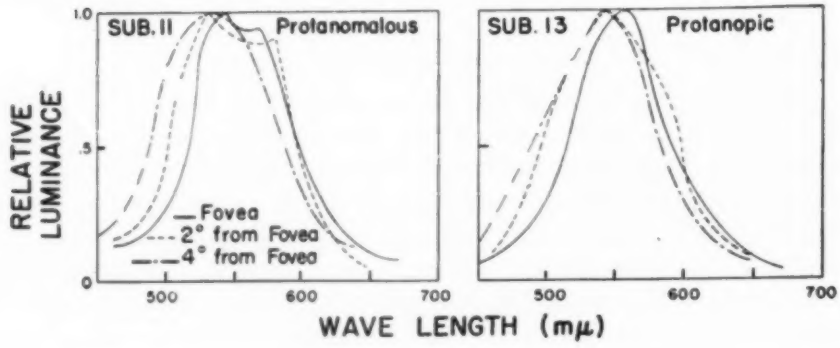

Fig. 7. Foveal and parafoveal luminance distribution curves for one protanomalous subject and one protanope.

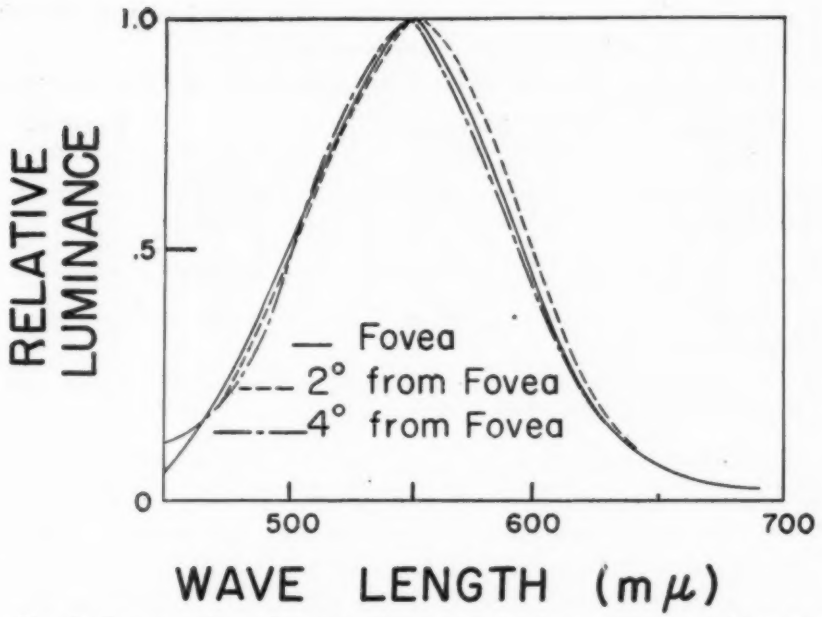

Fig. 8. Foveal and parafoveal luminance distribution curves for Subject 12 (an atypical protanope.).

It is possible that foveal fixation was not maintained, but there was no direct evidence that this was the case. The fact that the subject can fixate with his fovea when instructed to do so was proved by measuring his central visual acuity. An ordinary test card was used. The subject was instructed to use central fixation (i.e. to look directly at the letters). It was found that the visual acuity was 20/20 under ordinary room illumination.

The fact that Subject 12 is only partially color-blind is positive evidence that his fovea is not totally devoid of cones.

If it is true that the anomalies connected with the luminosity curve of this subject are dependent, at least in part, upon the presence of rods in the fovea, there still remains the separate question of the relation of this anomaly to the inability to differentiate red from green. Do these two things have any causal connection, or is it merely chance that they coexist in this individual?

PART III

COLOR MATCHING DATA

Color Matches at the Fovea Between a Yellow and a Mixture of Red and Green

This test involves a determination of the range of red-green mix-

tures that constitute a match for yellow. The matches were all made with the right eye while the left eye was occluded.

The stimulus pattern (Fig. 9A) consisted of two juxtaposed

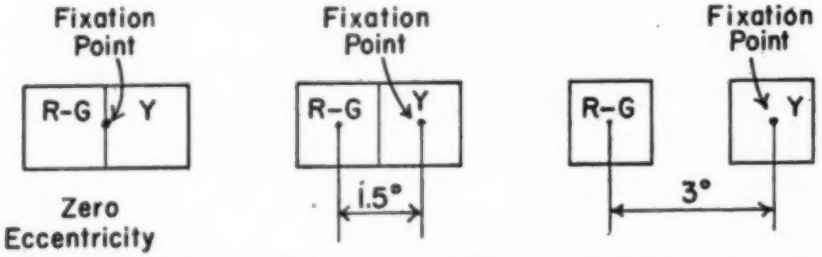

Fig. 9. Arrangements of the red-green (R-G) and yellow (Y) squares and the point of fixation for color-matching.

squares, each subtending a visual angle of 1.5°. One was yellow and the other involved a mixture of red and green. A point on the dividing line served as the fixation point. A narrow dark line was left separating the two squares so that the judgment of a color difference had to be based on color difference rather than the presence of a dividing line between the squares.

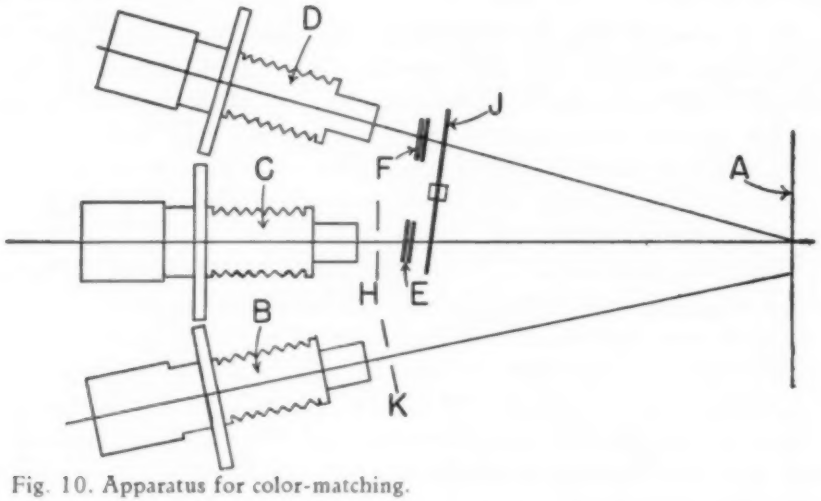

Fig. 10. Apparatus for color-matching.

The arrangement of the apparatus is shown in Fig. 10. The two colored squares are projected on a white screen (A). The yellow square is produced by projector B. The red-green square involves a coalescence of two squares, one red which is produced by projector C, one green produced by projector D.

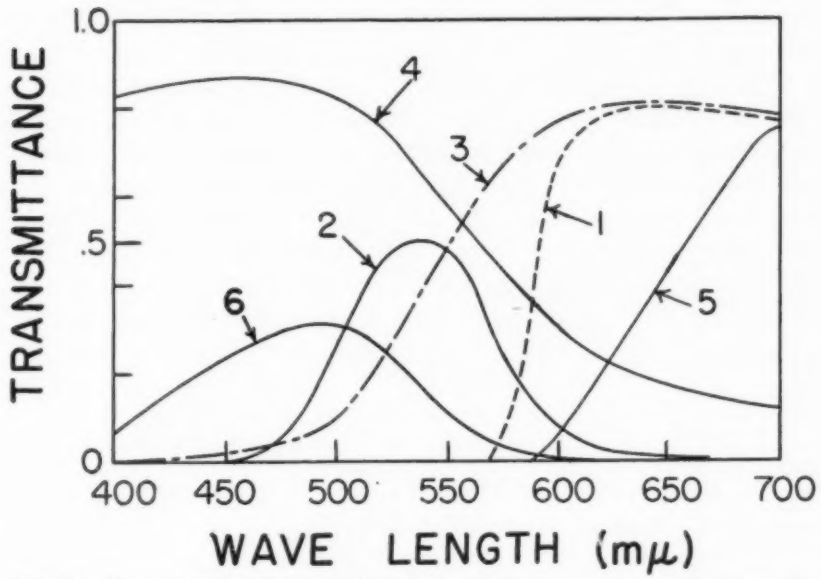

Fig. 11. Transmittance curves of the filters used in the color-matching experiments.

The three colors were obtained by means of red, green, and yellow filters whose transmission curves (1, 2, and 3) are shown in Fig. 11. The I. C. I. tristimulus coefficients for the three stimuli were computed by the weighted ordinate method.[8] The stimuli are plotted on the I.C.I. chromaticity diagram in Fig. 12. The energy source (a 500-watt projection lamp) was assumed to be equivalent to a black body having a color temperature of 3100°K, and the white cardboard screen was assumed to be non-selective. The yellow stimulus falls on a line between the red and green stimuli, which for a normal observer insures that a mixture of red and green in proper proportions will match the yellow.

The luminance of the red square was controlled by the pair of crossed polaroids (E) and that of the green square was controlled by the pair of crossed polaroids (F). The two pairs of polaroids were linked together so that when the transmittance of one pair was increased, the transmittance of the other was correspondingly decreased and vice versa. This is a convenient arrangement because if the diaphragm (H) is adjusted so that the red and green squares are equally bright when the polaroids are set for 50% of maximum transmittance each, then the relative amounts of red and green in the mixture can be varied by manip-

8. A. C. Hardy, Handbook of Colorimetry (1936).

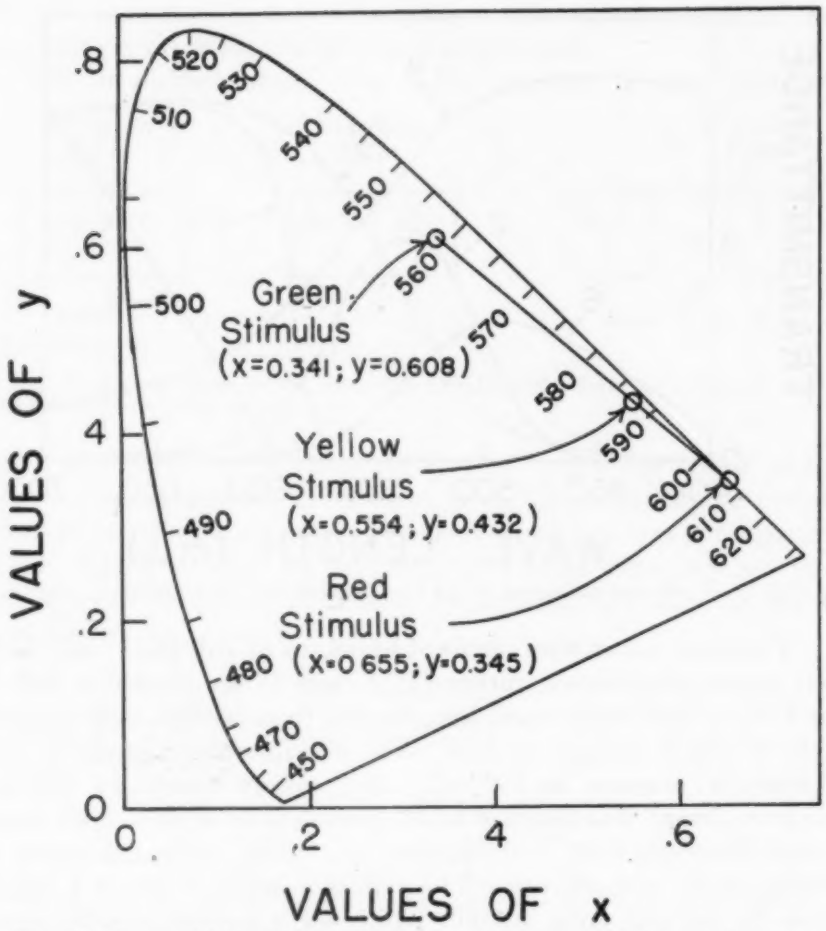

Fig. 12. Chromaticities of the stimuli used in the color-matching experiments.

ulating the polaroids without affecting the total brightness. The luminance of the green square was 23.3 c/m² as measured with a Macbeth Illuminometer by a normal observer when the crossed polaroids (F) were set for maximum transmittance.

A flicker photometer method was used for equalizing the brightnesses produced by the red and green stimuli when the polaroids were set for 50% of maximum transmittance. A sectored disk (J) was used to interrupt the red and green beams alternately. The speed was adjusted so that when the diaphragm (H) was adjusted to make the brightness of the red equal to that of the green, the flickering would reach a minimum or disappear altogether.

After each of the other subjects had completed this setting, the experimenter (Subject 4) manipulated the polaroids to equalize the brightness produced by the red and green for his own right eye. From this data one can determine indirectly the relative amounts of red light required to match the green in brightness. The data are summarized in Table I. An arbitrary value of one has been assigned to the amount of red required by Subject 4 to match the green and the intensities required by the other subjects are relative to this. As might be predicted from the luminance distribution curves, the deuteranopic and deuteranomalous observers require less red to match the green in brightness than the normal, and the protanopic and protanomaolus observers require more.

After each subject had adjusted the diaphragm (H) to make the brightnesses produced by C and D equal when the polaroids were set for 50% of maximum transmittance, the sectored disk (J) was removed.

TABLE I

Relative amounts of red required to match a standard green in luminance by flicker photometry.

Classification of Subjects	Subject	Amounts of Red Required
Normal	1	1.00
	2	.975
	3	1.00
	4	1.00
	5	1.00
Deuteranomalous	6	1.00
	7	.90
	8	.87
	9	.72
Deuteranopic	10	.775
Protanomalous	11	2.08
Protanopic	12	2.76
	13	2.88

The luminance of the yellow square was varied by means of a diaphragm in front of the projecting lens, until it matched by direct comparison that of the red-green mixture. The subject was then asked to fixate a point on the dividing line between the two squares as shown in Fig. 9A. This is called the foveal method of comparing the two stimuli. The experimenter then rotated the system of polaroids and asked the subject to report the moment that the red-green square be-

came greener or redder than the yellow square. Several determinations were made of the amount that the transmittance had to be varied before the subject noticed a difference in chromaticity. In other words, determinations were made of the two limits of the range of mixtures of red and green which constituted a match for yellow.

The entire procedure was performed in a dimly illuminated room with the luminance values of the projected targets being of such an order that both the photopic and the scotopic visual processes were brought into play.

The data are summarized in Table II.

As seen in the table, the range of red-green mixtures required by the normal, the protanomalous, and the deuteranomalous subjects to match a yellow is restricted so that one can call the mixture at the midpoint of the range, the match for the yellow.

TABLE II

Percentage (luminance units) of red in a red-green mixture required to match a yellow.

Classification of Subjects	Subject	Percentage of Red		
		Upper Limit	Lower Limit	Midpoint
Normal	1	57	46	51.5
	2	58	47	52.5
	3	66	52	59.0
	4	59	55	57.0
	5	58	50	54.0
				54.8 average
Deuteranomalous	6	65	57	61.0
	7	69	57	63.0
	8	69	54	61.5
	9	67	47	57.0
Deuteranopic	10	96	18	
Protanomalous	11	34	58	46.0
Protanopic	12	82	18	
	13	100	68	

It is of interest to note that the percentage of red in a red-green mixture required by the normal subjects in this investigation to match yellow at the fovea compares favorably with the value computed for the I.C.I. Standard Observer. The positions of the red, green, and yellow stimuli on the color mixture diagram are shown in Fig. 12.

They lie approximately on a straight line. The percentage of red (P RED) in a red-green mixture required by the I.C.I. Standard Observer to match the yellow was calculated by the following formula:[8]

$$P_{RED} = \frac{100}{1 + \left(\frac{y_{GREEN}}{y_{RED}}\right)\left(\frac{x_{RED} - x_{YELLOW}}{x_{YELLOW} - x_{GREEN}}\right)},$$

and was found to be 54.5. The average for the five normal subjects was found to be 54.8.

With the data at hand, it is not possible to evaluate the significance of the percentages of red required by the deuteranomalous and the protanomalous subjects, because the red, green, and yellow stimuli are all heterogeneous, and the abnormal luminosity curves will affect the colors.

A great deal more weight can be attached to data of this sort obtained with monochromatic stimuli. For comparison, the data for the

TABLE III

Percentage (luminance units) of red in a mixture of red (650 $m\mu$) and green (530 $m\mu$) required to match a yellow (590 $m\mu$). The yellow is mixed with 460 $m\mu$ when necessary to obtain an exact match.

Classification of Subjects	Investigator	Subject	Percentage of Red	Average
Normal		I.C.I. Standard Observer	47.4	47.4
Protanomalous	McKeon and Wright	A	51	45.5
		B	37	
		C	49	
		D	50	
		E	44	
		F	42	
Deuteranomalous	Pitt	W.F.T.	.226	27.8
		E.H.B.M.	.275	
		P.H.K.L.	.380	
	Nelson	A	.262	
		B*	———	
		C	.288	
		D	.233	
		E	.297	
		F	.262	
		L**	———	

* Data omitted because of poor wave length discrimination in red region.

**Data omitted because of questionable classification. The percentage of red required (25.5) corresponds to that required by deuteranomalous observers and the wave length discrimination curve corresponds to that of deuteranomalous observers, but the luminosity curve corresponds to that of a protanomalous observer.

I.C.I. Standard Observer and for several protanomalous and deuteranomalous observers examined by Pitt,[4] Nelson,[5] McKeon and Wright[7] are shown in Table III.

One can conclude from this data that the protanomalous subject does not differ significantly from the normal, but the deuteranomalous subjects require considerably less red.

It is most unfortunate that spectral stimuli were not used in the present investigation, because anomalous mixture coefficients probably constitute the most likely deviation from normal color vision that causes deuteranomalous observers to fail the Ishihara test, and certainly in the case of Subjects 6 and 7, no other deviations have been found which can account for it.

As seen in the data for the dichromats (10, 12, and 13) in Table II, the range of mixtures of red and green that match yellow is quite large, but does not extend all the way from pure red to pure green. This does not prove that these subjects are not dichromats, because the facts can be explained on the ground that the transmission curves for the yellow and green filters (Fig. 12(extend into the blue-green part of the spectrum which the dichromats can distinguish from the red end of the spectrum.

Substantiating evidence that Subjects 10, 12, and 13 were dichromats, was found in the fact that the green used in the experiments could be matched exactly by a mixture of red and a small amount of blue. This also showed that the green used in the red-green mixtures for matching yellow did not coincide with the red end of the dichromat's color mixture scale.

Color Matches Between a Yellow at the Fovea and a Red-Green Mixture in the Periphery

In the experiment described above, yellow and red-green squares were juxtaposed and a point on the dividing line was fixated. In the experiments that follow, this method of making a match is referred to as "zero eccentricity of the red-green square."

Matches were also made for various degrees of eccentrictiy of the red-green square. The yellow square was placed in various positions above, below, and to the right and to the left of the red-green square. The subject was asked to fixate the center of the yellow square. The amount of eccentricity of the red-green square is reckoned as the angular distance between the center of the yellow square and the center of the red-green square (Fig. 9B). However, as explained above, a zero-value

for eccentricity is used to designate the case of foveal comparisons, involving fixation of a point on the dividing line between the two squares (Fig. 9A).

The data for all of the subjects for various degrees of eccentricity to the right and to the left are shown in Fig. 13.

Color Matches Between a Red-Green Mixture at the Fovea and a Yellow in the Periphery

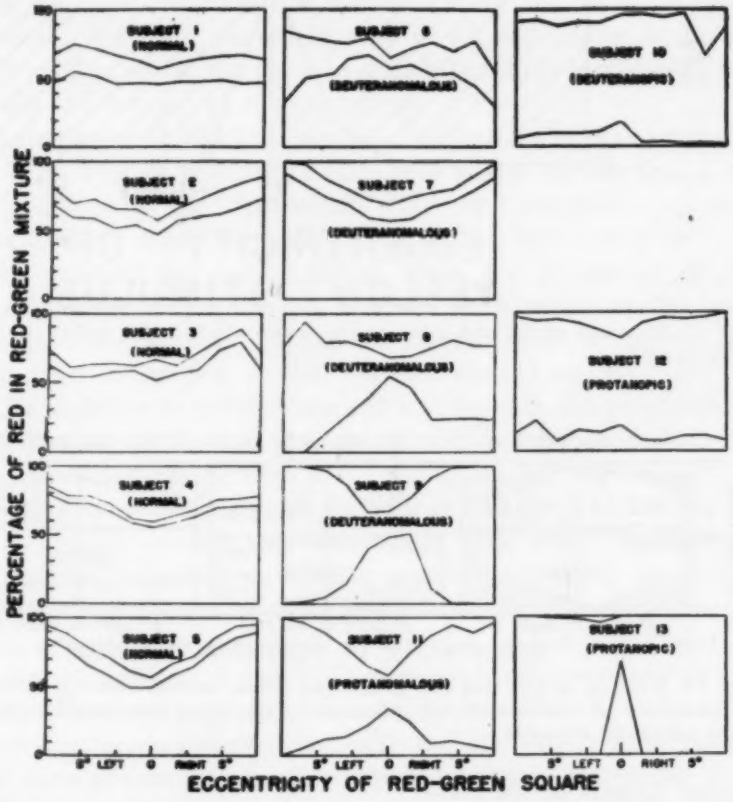

Fig. 13. Mixtures of red and green in the periphery which match yellow at the fovea. The two curves in each graph represent the upper and lower limits of the range of mixtures that constitute a match.

This involves the same procedure as in the last experiment except that the subject was instructed to fixate the center of the red-green square instead of the center of the yellow square. Filter No. 5 was substituted for Filter No. 1. The results for Subjects 4, 6, 7, and 9 for various degrees of eccentricity of the yellow square are shown in Figs. 14 and 15.

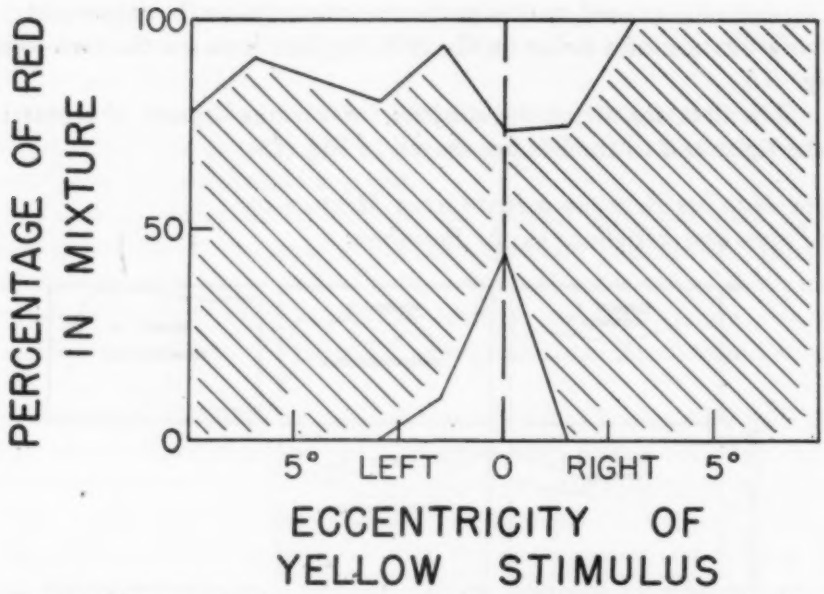

Fig. 14. Mixtures of red and green at the fovea which match yellow in the periphery (Subject 9).

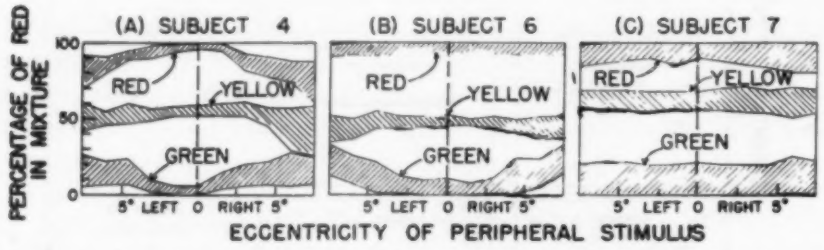

Fig. 15. Changes in hue that red, green, and yellow stimuli undergo as they move into the periphery. A mixture of red and green at the fovea was varied to match the hue of the peripheral stimulus.

Significant Aspects of the Data

Two aspects of the data in Fig. 13 will be given special consideration.

(1) Three of the anomalous trichromats (8, 9, and 11) are characterized by the fact that when an effort is made to match a yellow at the fovea with a mixture of red and green a few degrees from the fovea, it is found that the range of red-green mixtures that will match the yellow extends almost from 100% red to 100% green.

In trying to interpret these results, the first thing that comes to

mind is the proposition that in the normal retina, a dichromatic blue-yellow zone separates the totally color-blind periphery from the trichromatic field at the center, and it would seem to follow that the small trichromatic field found in Subjects 8, 9, and 11 probably represents nothing more than a restriction of the normal trichromatic field.

However, if red, yellow, and green in the periphery all look like the yellow seen by the fovea as Fig. 13 indicates, then it should be possible by switching fixation to the red-green mixture to find a limited range of red-green mixtures that will match the yellow in the periphery. This would not only prove that the parafoveal region is dichromatic but would also reveal the color in which the dichromatic region of the retina sees the red end of the spectrum.

Actually when this last part of the experiment was tried on Subject 9 (Fig. 14), it was found that he was not able to find a mixture of red and green at the fovea which would not match the yellow in the periphery except when the yellow was on the left and in this case the red-green mixture did appear redder when the percentage of red was high. According to the subject, the yellow stimulus in the periphery appears colored and also appears to change color whenever the red-green mixture is changed, so that the two always match.

The inability to differentiate red and green in the parafoveal region from yellow at the fovea is not characteristic of all anomalous trichromats, as is shown by the results in Fig. 13 for Subjects 6 and 7.

(2) The second aspect of the data in Fig. 13 which seems worthy of special consideration is that Subjects 2, 4, 5, and 7 require more red in a peripheral red-green mixture to match a yellow at the fovea than when both the red-green mixture and the yellow fall at the fovea.

No investigation was made in the case of Subjects 2 and 5, but, in the case of Subjects 4 and 7, it is possible to attribute this effect to variation in macular pigment, because (as shown in Fig. 15) when the red-green mixture is observed centrally and the yellow is in the periphery, the same percentage of red is required to make the match at all degrees of eccentricity.

There is also a variation in the relative concentration of rods and cones in going from the fovea to the parafovea, but this would be expected to produce no other effect than a change in saturation.

In the case of Subject 1 (Fig. 13), no increase in the percentage of red is necessary in the peripheral red-green square to match a yellow at the fovea. In this case, it must be assumed that the macular pigment is uniformly distributed over the area investigated.

If variation in retinal pigment is involved, allowance for this variation would have to be made in the evaluation of the paracentral luminosity data.

Hue Changes in the Periphery

One aspect of the transition from the trichromatic central region of the visual field to the dichromatic zone that surrounds it is the shift in hue that occurs for the intermediate colors between the invariable red, yellow, green, and blue. In the dichromatic zone, red and green become completely desaturated, and the intermediate colors either become completely desaturated or the hue is shifted all the way to blue or yellow. Changes in hue should therefore give some indication of the rate at which the dichromatic zone is being approached.

This aspect of paracentral color vision was investigated in the case of Subjects 4, 6, and 7. Three stimuli, a red (Filter 5), a yellow (Filter 3), and a green (Filter 2) were selected as the peripheral stimuli to be tested, and a red-green mixture (Filters 2 and 3) at the fovea was used for measuring the changes in hue.

In Fig. 15 are the data for Subject 4 (a normal) and for Subjects 6 and 7. In the case of Subject 4, the red and green stimuli shift toward yellow as they move into the periphery in accordance with the accepted notion of invariable and intermediate colors. In the case of Subject 6, the green shows the same sort of shift toward yellow as in the case of Subject 4, but there is no shifting of the red toward yellow. For Subject 7 there is no shift of red or green. This type of data indicates that these subjects (6 and 7), have, if anything, a smaller degree of red-green blindness in the periphery than a normal subject (4), that is, with respect to the ability to differentiate red, yellow, and green.

PART IV

ISHIHARA DATA

The Ishihara test (7th Edition, 11 Plates, 1936) was given to all subjects. In the routine tests for classifying the subjects and in the investigation of the effect of changing the quality of illumination, the test plates were kept at the normal testing distance (30 cm. to arms length).

A 100-watt incandescent lamp which formed the source of illumination was placed about three feet from the plates.

One method of investigating the effect of varying the quality of illumination is to observe the plates through red and red-free filters. Filters 5 and 6 (Fig. 11) were used for this purpose.

A red filter which reduces the problem to the perception of relative luminance of red light still permits a normal subject to give correct responses. On the other hand, a red-free filter will cause a normal subject to miss all of the plates.

All of the color-blind subjects observed the plates through red and red-free filters. In each case correct responses were obtained with the red filter. The deuteranomalous subjects who were able to pass some

TABLE IV

The effect of quality of illumination on the Ishihara test (F = Fail and P = Pass).

Subject	Illumination	Number of Plate									
		2	3	4	5	6	7	8	9	10	11
6	Addition of Red	P	P	P	F	F	F	P	P	P	P
	White	F	F	P	F	F	F	F	F	F	F
	Addition of Green			Failed all Plates							
7	Addition of Red			Passed all Plates							
	White	F	F	P	F	F	F	F	F	P	P
	Addition of Green										
8	Addition of Red			Passed all Plates							
	White	F	F	F	F	F	F	P	F	P	P
	Addition of Green			Failed all Plates							
9	Addition of Red	P	P	P	P	P	P	P	P	F	F
	White	F	F	P	P	F	F	F	F	F	F
	Addition of Green	F	F	P	P	F	F	F	F	F	F
10	Addition of Red			Passed all Plates							
	White	P	F	F	P	F	F	F	F	F	F
	Addition of Green			Failed all Plates							
11	Addition of Red			No Improvement							
	White	F	F	F	F	F	F	F	F	F	F
	Addition of Green			No Change							
12	Addition of Red			No Improvement							
	White	F	F	F	F	F	F	F	F	F	F
	Addition of Green			No Change							
13	Addition of Red										
	White	F	F	F	F	F	F	F	F	F	F
	Addition of Green										
	Correct Answers	8	25	5	74	8	87	5	73	—	—
	Expected Answers If Incorrect	3	70	2	91	—	—	—	—	5	73

of the plates with white light, failed all the plates when a red-free filter was used. Subjects 11 (protanomalous) and Subject 13 (protanopic) failed all of the plates with either white light or with the red-free filter. Subject 12 (protanopic) was able to pass Plate 2 with the red-free filter, although he failed all of them with white light.

The quality of illumination was also varied by using two sources of illumination, one white and the other red or green. The results for the deuteranomalous and deuteranopic subjects are summarized in Table IV.

A small addition of green light to the white light falling on the plates causes deuteranomalous (6 and 8) and deuteranopic (10) subjects to fail plates that they are able to pass with white light alone. The results of Subject 9 were not affected. The protanopic and protanomalous subjects fail all of the plates to start with, and the addition of green light cannot make the results any worse; nor did it improve the situation.

A small addition of red light helps the deuteranomalous (6, 7, 8, and 9) and deuteranopic (10) subjects to pass plates that they cannot pass with white light, but fails to help the protanomalous subject (11) or the protanopic subject (12). Presumably if enough red light had been added, the protanomalous (11) and the protanopic (12) subjects would have been able to pass the test also, because the problem eventually becomes equivalent to observing the plates through a red filter.

These facts are in general agreement with the finding of Hardy, Rand, and Rittler[1] that substitution of artificial (redder) illumination for daylight improves the performance for deuteranomalous and deuteranopic observers but has little effect on the performance of protanopic and protanomalous observers.

The effect of varying the distance of observation was also investigated. All of the results obtained are shown in Table V. Various distances of observation were used, but these were not accurately measured or recorded. "Near" may mean anything from 30 cm. to arms length, and "far" may mean anything from 2 to 6 meters. In general if distance helps, the effect begins between one and two meters.

Increasing the distance of observation definitely improves the performances of the deuteranomalous observers (6, 7, 8, and 9), and for deuteranopic subject (10). Increasing the distance fails to improve the performance of the protanomalous observer (11), or that of the protanopic observers (12 and 13).

TABLE V

The effect of distance of observation on the Ishihara test.

Subject	Distance	Number of Plate									
		2	3	4	5	6	7	8	9	10	11
6	Near	F	F	P	F	F	F	F	F	F	F
	Far	P	P	P	P	P	P	P	P	P	P
7	Near	P	F	P	F	F	F	F	F	P	P
	Far	P	P	F	P	P	P	P	F	P	P
8	Near	F	F	F	F	F	F	P	F	P	P
	Far	P	P	P	P	P	P	F	P	P	P
9	Near	F	F	P	P	F	F	F	F	F	F
	Far	P	P	P	P	P	P	P	P	P	P
10	Near	P	F	F	P	F	F	F	F	F	F
	Far	P	P	P	F	P	F	F	F	P	P
11	Near	F	F	F	F	F	F	F	F	F	F
	Far			No	Impr	ovem	ent				
12	Near	F	F	F	F	F	F	F	F	F	F
	Far			No	Impr	ovem	ent				
13	Near	F	F	F	F	F	F	F	F	F	F
	Far			No	Impr	ovem	ent				

The advantage in increasing the distance of observation in the case of deuteranopic and deuteranomalous subjects arises from the fact that the stimulus is confined to the rod-free area in which the visibility curve is shifted toward the red as compared with the periphery. Distance fails to help the protanope or protanomalous observer because the visibility curve at the fovea is shifted toward the green as compared with that of a normal.

Another factor has to be reckoned with in the case of the deuteranomalous observers (8 and 9) and the protanomalous observer (11), namely, that reds, yellows, and greens can be differentiated at the fovea but not in the surrounding region of the retina. The fact that subjects 6, 7, and 10 get the same type of improvement as subjects 8 and 9 when the target is confined to the fovea indicates that this factor is not important.

Summary of Reasons for Failing the Ishihara Test.

This investigation has not made it clear why a deuteranomalous subject fails the Ishihara test. The tests were not properly designed,

however, to bring out the one characteristic anomaly of this type of observer which appears to be the most likely cause for failing the Ishihara test. This anomaly is a reduction in the percentage of red (measured in luminance units) in a red-green mixture which is required to match a yellow. This is correlated with a shift of the minimum in the wave length discrimination curve at the red end of the spectrum, and an increase in the threshold of wave length discrimination in the region from 520 mμ to 600 mμ (see Fig. 20, Reference 4). This last feature makes it possible to confuse yellow-greens and yellows, and this appears to be the most likely cause for the failure to pass the Ishihara test for this type of observer.

The deuteranope not only confuses yellow with orange and yellow-green but with red and green as well, and it is understandable that he should fail the Ishihara plates.

Using a mixture of red and white light on the plates, or increasing the distance so that the plates are confined to the fovea brings out luminance differences which outweigh the color differences and which give the right answers.

The anomalous mixture data of the deuteranomalous observer also makes it possible for him to confuse stimuli of different wave length composition which could be distinguished by a normal observer and vice versa, but a spectrophotometric analysis of the reflectance from the colored spots would be necessary to evaluate the importance of this factor.

Some protanomalous observers have good wave length discrimination at the red end of the spectrum and appear to be normal in every way except for the luminosity curve. This introduces luminance relations which are adverse for passing the test.

Protanopes are also confronted with adverse luminance relations for passing the test, but these subjects as well as some protanomalous observers are faced with poor wave length discrimination at the red end of the spectrum in addition to the luminance problem.

Certain of the subjects showed some indication that the central trichromatic region of the visual field was restricted. Although this condition might contribute to the failures on the Ishihara Test, Subjects 6 and 7 prove that this anomaly is not the essential cause of failure.

ABSENCE OF ACCOMMODATION—A CASE REPORT*

E. E. Reese and H. W. Hofstetter†
School of Optometry
The Ohio State University, Columbus, Ohio

The absence of accommodation as an isolated anomaly is probably rare. This report deals with a 36-year-old patient who demonstrates no accommodation at all and gives evidence that no accommodation was present during early childhood.

The patient, Mrs. L., was examined in November, 1946, at the office of the senior author and on a later date was brought to the Optometry Clinic for special tests made by several of the staff members. The following is a summary of the findings obtained.

NAME: Mrs. L.

AGE: 36 years.

OCCUPATION: Routine office work.

CHIEF COMPLAINTS: Frequent diplopia at near, frequent headaches, and eye fatigue when doing close work. Desires to obtain less unsightly lenses, the present glasses containing highly conspicuous base-in prism bifocal segments.

GLASSES WORN AT TIME OF EXAMINATION:

O.D. + 1.00 D. Sph ⌒ —0.50 D. Cyl. axis 180. V.A. = 20/20.
Add: + 2.00 D. Sph. ⌒ 5△base-in.
O.S. + 0.75 D. Sph. V.A. = 20/20.
Add: + 2.00 D.Sph. ⌒ 5△base-in.

HISTORY: In about the fourth grade, at about the age of 10, single vision glasses were prescribed for reading and desk work, none for distance. She distinctly recalls that distant vision through this early pair of glasses was extremely blurred, necessitating the removal of the glasses for blackboard work and other distant seeing, and that it was necessary to wear the glasses to see desk work clearly. She recalls that it was this inconvenience that finally prompted the prescribing of bifocals at about the age of 15 while in high school. The present bifocals containing the prism segments were prescribed approximately 13 years

*Submitted on January 28, 1947, for publication in the March, 1947, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrists. Fellows, American Academy of Optometry.

ago, at about the age of 23. Whether or not this was the first pair to include prism segments is not recalled, but she reports that this was the first prescription to give marked relief from diplopia at near.

The patient does not recall the onset of her ocular difficulty and presumes therefore that it has always been present. She reports that neither her family nor her family physician attributed the condition to any early illness or accident. The patient is not aware of any similar ocular condition among her relatives.

PRELIMINARY EXAMINATION: External inspection and ophthalmoscopy showed no pathological anomalies; lid action normal; versions normal, the monocular nasal rotations for each eye exceeded 45°; the diplopia field obtained with a red glass filter in front of one eye showed less than one degree variation in the relative positions of the red and white images of a white fixation spot as it was moved about all parts of the black surface on a tangent screen one meter square at a distance of approximately one meter in front of the two eyes; the pupillary reflex to light was normal; ocular tensions felt normal; occlusion tests with fixation at six meters showed neither squint nor observable heterophoria; the presence of the crystalline lenses was verified by the images of an illuminated ophthalmoscope formed by the lens surfaces.

OPHTHALMOMETER:

O.D. 43.50 at 5° ⌒ 44.75 at 95°.
O.S. 44.12 at 6° ⌒ 45.00 at 96°.

RETINOSCOPE:

O.D. +1.00 —.50 x 170°.
O.S. +1.00.

SUBJECTIVE:

O.D. +.75 —.75 x 170°.
O.S. +.75 sph.

6M. PHORIA:

Vertical = ortho.
Lateral = 1△exo.

40 CM. PHORIA:

14△ to 16△ exophoria through +2.25 sphere added to the subjective finding to permit clear vision.

6 M. DUCTIONS:

Base-in-to-break = 9 to 10△,
-to-recovery = 1 to 2△.

Base-out-to-break (no blur) 4 to 5△.
-to-recovery = 0 to 3△.

40 CM. DUCTIONS: (Through +2.25 sphere added to the subjective finding.)

Base-in-to-break (no blur) = 24 to 26△.
-to-recovery = 18 to 20△.
Base-out-to-break (no blur) = —8 to —9△.
-to-recovery = —10 to —12△.

STEREOPSIS: The stereopsis was measured on the Royal Rotoscope[1] with target Nos. 40, 41, 42, and 43 with the convergence stimulus set at 1△ base-in on the infinity scale. The score of 40%, and the associated description of what was seen quite definitely indicated the presence of stereopsis.

NEAR POINT OF CONVERGENCE: This test was made in several ways, with the glasses on, with the subjective correction in place, and without lenses. Several types of test objects were used, such as a pencil, a black spot on a white card, and an illuminated ophthalmoscope bulb. In each instance, as the fixated test object was brought toward the eyes, it could be observed that the eyes failed to continue to converge at the moment that diplopia was reported. The several techniques showed uniformity of results. The following measurements were obtained in seven successive trials with an illuminated ophthalmoscope bulb: 64, 57, 53, 57, 52, 58, and 56 cm. from the spectacle plane, the average value being 56.7 cm. Assuming the spectacle plane to lie 2.7 cm. in front of the center of rotation and the interpupillary distance to be 60 mm., the equivalent convergence in prism diopters is computed to be 10 prism diopters.

NEAR POINT OF ACCOMMODATION: In preparing to do the phoria and duction tests at 40 cm. it was discovered that an add of +2.25 was necessary to make the test chart sufficiently clear to proceed with the tests. Subsequent push-up tests both monocularly and binocularly and through various amounts of spherical lenses added to the subjective correction showed less than a half-diopter range to the point of blurring. The same results were obtained when the patient herself held the test card in both hands and moved it toward the eyes.

To determine whether the apparent amplitude of less than a half-diopter was actual accommodation or only a depth-of-focus range, the retinoscope was employed to determine the refractive state both during the fixation of a distant object and during the attempt to see a near object clearly. The latter was accomplished by scoping one eye through

an aperture in a test card held by the patient at a distance of approximately 60 cm. (arm's length) and with a pair of +1.00 spherical auxiliary lenses added to the subjective correction. The test card was seen singly, somewhat blurred, and just readable at this distance. The "with" and "against" limits of the skiascopic reflex were determined several times by each observer for both sets of conditions; i.e., distant and near fixation. The averages for the two sets of conditions were identical, indicating no difference in refraction and therefore no accommodation response. The possibility of experimental error invalidating the results was ruled out by the fact that the average error of the observers in the several determinations of the "with" and "against" limits was less than 3 cm., representing less than 0.03 diopters of probable error.

DISCUSSION

If the case history is ignored, the low amplitude might appear to be merely an extreme deviation from the mean amplitude expected for the age. In this sense it should be compared to the findings obtained by investigators who have published the results on large numbers of cases.

Duane[2] published the amplitudes measured on over 4,200 eyes. His records show that the lowest age at which less than 0.50 D was obtained was 57, with a few subjects between 50 and 57 showing between 0.50 and 0.62 D. His average amplitude for the age of 36 was approximately 6.75 D, with the lowest value falling well above 4.00 D.

Donders'[3] data, obtained on over 100 subjects, showed 62 years to be the lowest age at which less than 0.50 D was obtained. His average amplitude, measured from the spectacle plane, for the age of 36 was approximately 8.00 D, with the lowest value falling well above 6.00 D.

Kaufman's[2] data, obtained on about 400 eyes, showed 55 years to be the lowest age at which less than 0.50 D was obtained. His average amplitude for the age of 36 was approximately 6.25 D, with the lowest finding falling well above 5.00.

The results of these three investigators indicate that the present case falls far outside of the range of normally distributed amplitudes.

The case history indicates that the accommodation was inadequate or absent at a very early age.

The possibility of a IIIrd nerve palsy is not indicated by other symptoms ordinarily associated with a lesion in the IIIrd nerve nucleus. Inasmuch as the defect is bilateral, it is not likely that peripheral nerve

lesions are involved. There is nothing whatsoever in the history to indicate a pathological lesion.

Of interest is the comparison of positive fusion limits obtained in the base-out ductions at distance and near and in the near point of convergence tests. Expressed in terms of deviation from parallelism, the base-out-to-break at 6 M. represents a total convergence of 5 to 6△, the base-out-to-break at 40 CM. represents a total convergence of 6.5 to 7.5△, and the near point of convergence represents an average of 10△. It is doubtful that the three sets of values can be considered to differ significantly. Similarly the base-in ductions at 6 M. and at 40 CM. are essentially identical when expressed in terms of deviations from parallelism, the former giving a maximum divergence value of 8 to 9△, and the latter giving a maximum divergence value of 8.5 to 10.5△. The phorias at 6 M. and 40 CM. also represent essentially identical relative positions of the lines of sight.

A series of twelve base-out exercises were given during a period of six weeks with no increase in the base-out limits.

This case offers special evidence for the separability of the convergence components postulated by Maddox[3] in that it illustrates the absence of accommodative convergence with the fusional convergence remaining intact. The absence of accommodative convergence in this instance is of course attributable to the absence of accommodation itself, or, more specifically, to the absence of innervation to accommodation.

Whether or not a genetic factor is involved could not be established.

CONCLUSION

A case of a 36-year-old woman with absence of accommodation is described. Evidence is given that this anomaly has existed since early childhood. Associated symptoms indicating a IIIrd nerve palsy were absent. Certain theoretical implications are discussed.

REFERENCES

1. Orthoptic Procedure with the Royal Rotoscope Model 50, Copyright 1940 by The Wottring Instrument Company, Columbus, Ohio.

2. Hofstetter, H. W., A Comparison of Duane's and Donders' Tables of the Amplitude of Accommodation, American Journal of Optometry and Archives of American Academy of Optometry, Vol. 21, No. 9, Sept., 1944, pp. 345-363.

3. Maddox, E. E., The Clinical Use of Prisms, Fifth Edition, London, 1907.

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ON THE PREPONDERANCE OF CRYSTALLINE LENSES SHOWING AT LEAST SOME SIGNS OF OPACITIES

As an army ophthalmological investigation,[1] an unselected group of 300 men of military age were given examinations to determine the presence or absence of opacities in the crystalline lens. None of the men examined had complained of ocular symptoms, all had visual acuities acceptable to the military forces and none were found to have diseases which might contribute to a condition of cataract. The average age of the group was slightly in excess of 28 years.

[1]J. H. Doggart. Partial Cataract in Men of Military Age. Arch. Ophth. 35.3.280. 1946.

In spite of these very favorable factors it was found that some small opacity could be found in the crystalline lens of 94 per cent of the examined subjects, which indicates again that a crystalline lens which is entirely free from opacities is the exception rather than the rule. In fact, the data presented indicate that cataract (in its very mildest form as evidenced by only one or more very small opacities) is almost as prevalent as ametropia and that the opacity-free crystalline lens is almost as rare as the eye with absolute emmetropia.

This does not mean, however, that all of these patients have "cataracts" in the true sense of the word. Nor does it mean that these patients will develop this visual impairment in later years. It merely means that various small lenticular opacities are found in most lenses to a degree as to make the finding of these an almost normal condition. As long as these opacities do not interfere with visual acuity these may be recorded as present on the examination chart by the opometrist, and the case kept under observation, provided of course, that all other visual care is supplied.

In making their ophthalmoscopic examinations optometrists have for years found these very small opacities in eyes otherwise free from pathology and have given these same patients many fine useful years of vision through the correction of ametropias and imbalances of the accommodative convergence relationships. In 95 per cent of these cases these small opacities do not impair vision in the slightest degree even late in life.

The subject of why these opacities occur is still open to some question. There are several theories relating to this. But the fact that they are present in most patients should be recognized and kept in mind by all optometrists. For the record it might be added that there is no known therapeutic medical treatment to either remove the opacities or prevent them from forming in the lens.

CAREL C. KOCH

A. O. A. ANNIVERSARY

The year 1947 marks not only the 50th anniversary of the founding of the American Optometric Association but also rounds out the 25th year that Dr. Ernest Kiekenapp has served as secretary of that optometric organization. Both events merit attention.

The A. O. A. in its first 50 years has served optometry well. Starting shortly before the turn of the century with but a small mem-

bership, it has grown into a large and powerful force in American health circles. As the official spokesman for all optometrists in legislative, political, public health, civic and public relations matters, it has assisted materially in bringing the work of the optometrist to the attention of our governmental units and civic leaders. As a result, members of the optometric profession are now universally given the legal status required to effectively place them on a par with members of other professions.

This first 50 years has not been completed without its trials and disappointments, yet in retrospect the successes of the past stand out conspicuously and the unity of purpose which was ever a compelling force behind the A. O. A. leaves no doubt as to its ultimate success.

During the last 25 years the A. O. A. has been served faithfully by its present secretary, Dr. Ernest Kiekenapp. Elected first in 1922 at Indianapolis, Indiana, Kiekenapp has typified the work of the association. No job too large for him to tackle, none too small for his attention. Week in and week out, year after year, the detailed business of the association passes across his desk, and to each matter he has applied himself with his usual thoroughness. Much of the past success of the A. O. A. has been due to this meticulous attention to detail which has characterized our National Secretary. Much too, to his genial disposition and ability to get along with people.

The first 50 years of the A. O. A. have been devoted largely to getting optometry well intrenched in the sociological life of this country. This work has succeeded far better than is generally realized. Optometrists today are accepted by the public as the refractionists of America and in this they owe no small debt to the collective work done in their behalf by that great group of past and present officers and committee men who have served the profession through the A. O. A. during the past 50 years. In great part their work was a labor of love and as such it was performed thoroughly and with complete effectiveness. To this group we say "well-done."

Optometrists in America can ever be thankful that they have always had single and unified leadership. There has never been a thought of having two large national societies of optometrists in constant rivalry. We have always looked only to the A. O. A. for leadership and it has never failed us. It is our earnest hope that this condition will continue in the years to come.

These years will bring new problems to the A. O. A. Some will deal with optometric undergraduate education, others with public health programs and industrial eye work. But in these and other fields the

A. O. A. has within its ranks the specialists to rise again to the necessary heights to overcome these problems as they occur.

The A. O. A. has completed 50 years. The past is bright with fine achievement. In this Kiekenapp has played an important part. We look forward to the years ahead with optimism and with the faith that under the broad wing of A. O. A. leadership optometry will continue its technical and professional progress to the end that the visual problems of all our people will be well served.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news professional problems and ideals, as these relate to the Academy.

LOCAL CHAPTER ACTIVITIES

INDIANA CHAPTER

Plans for holding seminars this Spring and next Fall in place of the regular meetings were discussed at the January session of the Indiana Chapter, American Academy of Optometry.

The chapter also elected new officers for 1947, as follows: President, R. W. Tubesing, Richmond; president-elect, Robert Ledig, Indianapolis; vice-president, Kenneth Kintner, Mishawaka; secretary-treasurer, J. R. Shreve, Indianapolis; executive council: Irvin M. Borish, Kokomo: J. P. Davey, Indianapolis, and N. A. Bixler, Decatur.

A vote of thanks was extended to Dr. I. M. Borish, retiring president, for leadership given the chapter.

This meeting of the Indiana chapter was held in conjunction with the Golden Jubilee convention of the Indiana Optometric Association.

PROGRAM OF THE ANNUAL MEETING OF ACADEMY AT PHILADELPHIA

BELLEVUE-STRATFORD HOTEL

SUNDAY, MAY 18, 1947

9:00 A. M.—Registration.

10:00 A. M.—Business Session.

J. Fred Andreae, O.D., President's Annual Report.

Carel C. Koch, O.D., Secretary's Annual Report.

Report of Local Chapters.

Committee Reports

Special Report No. 2, "Definition and Measurement of Torsion," and Special Report No. 3, "Definition and Measurement of Cyclophoria with Converged and Elevated Lines of Sight."

Committee on Nomenclature and Standards. Glenn A. Fry, Ph.D., Chairman.

1:30 P. M.—"Selection and Training of Optometrists for Special Military Duties," Henry A. Imus, Ph.D.

1:50 P. M.—Discussion.

2:05 P. M.—"Organization of the Specialties in Optometry." Galen F. Kintner, O.D., Wabash, Indiana.

2:25 P. M.—Discussion.

2:40 P. M.—"The Basis of Failure on Color Blindness Tests," Charles S. Bridgman, Ph.D., School of Optometry, Ohio State University.

3:00 P. M.—Discussion.

3:15 P. M.—"The Use of Cycloplegics in Refraction."

Part I—Historical Survey and Review of the Literature.

Part II—Data on the Clinical Use of Cycloplegics. Robert E. Bannon, O.D., Dartmouth Eye Institute, Hanover, N. H.

5:15 P. M.—

7:30 P. M.—Contact Lens Section. Eugene Freeman, Ph.D., chairman.

MONDAY, MAY 19, 1947

9:00 A. M.—Orthoptics Section, E. J. Margaretten, O.D., chairman. "Lecture and Demonstration on the Latest Developments in the Correction of Squint," E. J. Margaretten, O.D., New York, N. Y.; M. N. Chodroff, O.D., Brooklyn, N. Y.

12:00 A. M.—Recess.

1:30 P. M.—"Certain Variations in the Angle of Deviation in Concomitant Squint," H. W. Hoffstetter, Ph.D. School of Optometry, Ohio State University.

1:50 P. M.—Discussion.

2:00 P. M.—"The Effect of Prism on Esotropia, A. Case Report," Mathew Alpern, O.D., H. W. Hofstetter, Ph.D., School of Optometry, Ohio State University, Columbus, Ohio.

2:20 P. M.—Discussion.

2:30 P. M.—"A Clinical Evaluation of the Compensation for Prismatic Imbalance," V. J. Ellerbrook, M. Sc., Research Fellow, Physiological Optics, Ohio State University.

3:00 P. M.—Discussion.

3:10 P. M.—"Analysis of Successful and Failure Aniseikonic Cases" (a Study of the Data in 200 Cases), Robert E. Bannon, O.D., Rudolph T. Textor, O.D., Dartmouth Eye Institute, Hanover, N. H.

3:50 P. M.—Discussion.

4:10 P.M.—"Significance of Visual Acuity Measurements Without Glasses," Glenn A. Fry, Ph.D., School of Optometry, Ohio State University.

4:30 P. M.—Discussion.

4:40 P. M.—"The Theory and Application of Tri-focal Lenses," Roy Marks, O.D., Dayton, Ohio.

5:00 P. M.—Discussion.

7:00 P.M.—Aniseikonic Section, Harold Fisher, O.D., chairman.

TUESDAY, MAY 20, 1947

All day session at Pennsylvania State College of Optometry. Chartered buses will leave the hotel at 9:30 A. M. for the college. Lunch will be served at the college. The program will consist of a paper on "Ocular Neurology" in three parts.

1. "Ocular Neurology Illustrated with Cranial Specimens," Onfrey G. Rybachok, M.A.

2. "Ocular Neurology in Disturbances in the Form and Color Fields," Harold Simmerman, O.D.

3. "Ocular Neurology in Disturbances of Single Binocular Vision."

7:00 P. M.—Banquet.

WEDNESDAY, MAY 21, 1947

9:30 A. M.—"Believe with Me," J. Nupuf, O.D., Canton, Ohio.

9:45 A. M.—Discussion.

10:00 A. M.—"An Analysis of a Number of Cases Seen in an Industrial Eye Clinic," Fred Jobe, Rochester, New York.

10:30 A. M.—Discussion.

10:50 A. M.—"The Basis of Visual Fatigue," S. H. Bartley, Ph.D., Dartmouth Eye Institute, Hanover, N. H.

11:35 A. M.—Discussion.

12:00 A. M.—Recess.

1:30 P. M.—"Professional Ethics," Eugene Freeman, Ph.D., Chicago, Illinois.

1:50 P.M.—Discussion.

2:00 P. M.—Final Business Session.

Current Comments by Virginia Huck

Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

WHAT'S YOUR ZONE NUMBER?

The journal has a favor to ask its subscribers. We finally have been promised new electric addressograph equipment to replace machinery which broke down during the war. Delivery will be some time in May.

This will necessitate having new plates made for all our subscribers, and for these, we need your post office zone numbers.

We, of course, already have many of these, but still lack some, and as this number on your envelope expedites the delivery of the journal we ask that you drop us a line before April 1, giving us your zone number. A post-card will do. Thanks.

WANT TO ADD THIS TO YOUR LIBRARY?

Dartmouth Eye Institute has good news for optometrists who are acquainted with problems in the field of subnormal vision.

The Institute reports they have on hand a limited number of reprints, and also the original unabridged version, of V. S. Ellerbrock's, "Report on a Survey of Optical Aids for Subnormal Vision."

This report, prepared to guide the Committee on Sensory Devices of the National Research Council, deals with the theory and practical aspects of telescopic spectacles, loupes, reading-glass magnifiers and projection systems, as well as with recommendations for possible improvement in these devices.

This is the only comprehensive review on this subject published to date[1], and well worth adding to an optometric library.

Copies of this report either in the condensed or unabridged form will be mailed to any professionally interested person upon request to: Dartmouth Eye Institute, 4 Webster Avenue, Hanover, New Hampshire.

MEETINGS SPUR PROGRESS

After a war-necessitated slow-down, optometric activities again are getting into high gear all over the country. In January and February many important meetings were held to discuss visual problems and ways to correct them.

In Huron, South Dakota, 22 optometrists attended a visual training conference in January. Dr. H. C. Sherratt of Minneapolis, Minnesota, lectured on visual psychology.

The annual mid-winter meeting of the Optometric Foundation was held in January in New York City. Featured on the program were Dr. E. F. Richardson, Los Angeles, California, president of the American Optometric Association, and Professor George Wald of Harvard University who has conducted extensive research in the chemistry of retinal processes, the vitamin A factor in vision, and spectral sensitivity.

Also held in New York City in January was the quarterly meeting of the Better Vision Institute. At this meeting advertising plans for the coming year were discussed, including launching of a new cartoon called "Ups and Downs with the Stares." This cartoon, according to BVI officials, will "poke fun at the public in a friendly fashion while preaching the need for professional eye care on a periodic basis."

In Cleveland, Ohio, the Cleveland Contact Lens Center, Ltd., newly established visual clinic, was host to approximately 175 optometrists and their wives at an introductory dinner February 5. The work to be carried on by the center was outlined to guests. Dr. Glenn A. Fry of Ohio State University was guest of honor.

At Purdue University, Lafayette, Indiana, 34 American Optometric Association delegates from 22 states and the Bahama Islands met in February for a seminar on occupational vision. Among the speakers known to optometrists were: Drs. Richard Feinberg, Joseph Tiffin, Marguerite Eberl, Hedwig S. Kuhn, Frederick W. Jobe, and Carl F. Shephard.

Meetings stimulate progress and advance reports indicate that the

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1. Journal of the Optical Society of America, December, 1946.

remaining months of 1947 will be equally busy with many additional optometric gatherings.

THREE ANNIVERSARIES

Not only is 1947 shaping into a year of progress for optometry, but it will be a memorable one as well. Three important optometric groups are celebrating anniversaries this year.

The American Optometric Association, senior member of the trio, is 50 years old; the American Academy of Optometry, 25, and the Distinguished Service Foundation of Optometry, 20.

Each of these groups has contributed immeasurably in its own way to the progress made thus far by optometry. Each has ambitious plans for the future. Each is working toward the same goal—better vision for more people. And what is important to optometrists, these groups are coordinating their programs and working in unison.

A GOOD VIEWPOINT

A Louisiana high school student is setting the pace for the younger generation when it comes to planning her own professional future. The following letter was received by the American Academy of Optometry:

> "I am a high school student and work part time in my father's optometric office. I am very interested in the vocation and intend to further my study of optometry after I finish high school. I therefore want to be sure I am getting into my high school program all subjects which I may need to enter the Academy. Would you kindly send me a folder with a list of the qualifications for entrance?"

Would that all prospective optometry students planned this far ahead!

JUBILEE CONGRESS

The American Optometric Association will hold its "Golden Jubilee Congress" at the Hotel Chelsea, Atlantic City, New Jersey, June 22-25, 1947.

Because of other conventions and generally crowded conditions in Atlantic City, the AOA urges delegates, officers, and all planning to attend to write the Hotel Chelsea immediately for room reservations.

ATTENTION, ONE-EYED BANKERS

Last month the Editor outlined the progress made during the past twenty-five years in the art of fitting artificial eyes[1].

[1]Carel C. Koch. The Refined Art of Fitting Ocular Prosthesis. Amer. Jour. Optom. & Arch. Amer. Acad. Optom. 24.2.81-83. 1947.

Data recently released by the American Optical Company further substantiates his comment that a patient needing an artificial eye today is luckier than the patient of even five years ago.

Artificial eyes processed by the AO company are made of plastic and are practically unbreakable—previously they were made of glass.

Fitters now can "tailor" the moulded plastic eye to fit any ocular cavity—formerly patients had to hunt through hundreds of sizes and shapes of glass eyes to find one that fitted.

A special technique for hand-coloring the iris of the plastic eye makes it possible to match the patient's good eye—matching was next to impossible with old style glass eyes.

A review of this AO product brings to mind the famous story of the one-eyed banker, and now apparently science has really put "the friendly look" in artificial eyes.

SPECIAL REPORT

AN OUTLINE OF MOTOR VEHICLE TESTS FOR LICENSE APPLICANTS IN CALIFORNIA*

Kenneth H. MacPherson†
Stockton, California

At the request of the California State Association of Optometrists, the following outline for making the Motor Vehicle tests was revised from the original which was compiled a few years ago. This outline has been prepared to provide a helpful basis whereby optometrists may standardize their methods. It also standardizes the manner in which the application form, Figure 1, is filled out, thereby being of greater assistance to the Motor Vehicle Department.

The fact that the tests as outlined here have been taken on one type of instrumentation does not mean that they must always be made on these instruments. These tests are readily adaptable to other instrumentation.

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*An abridgment of the material presented to the members of the California State Association of Optometrists. Submitted on November 14, 1946, for publication in the March, 1947, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist.

SPECIAL REPORT

DL-62 (REVISED)

Application No. _____ DEPARTMENT OF MOTOR VEHICLES
DIVISION OF DRIVERS LICENSES
Sacramento

Examining Point _____
Date of Application _____

FULL NAME _____

RESIDENCE ADDRESS _____

PREVIOUS LICENSE No. _____ DATE OF BIRTH _____

REPORT OF EXAMINATION (*Confidential to Department*)

1. ACUITY

	Glasses Without	Glasses With	Distance B
Both eyes	20/	20/	
Right	20/	20/	
Left	20/	20/	

If possible, measure acuity at 20 ft. If not, please state distance. To what acuity can vision be brought by correction?
R 20/_____ L 20/_____
Are new lenses being fitted?_____

2. EVIDENCE OF SUPPRESSION_____
3. COORDINATION
A. Phorias—(To be measured at 20 feet
Horizontal Exo°_____Eso°_____
Vertical R Hyper°_____L Hyper°_____
B. FUSION
Excellent___Good___Poor___None___

Method or Equipment Used

C. DEPTH PERCEPTION
Excellent___Good___Poor___None___

Method or Equipment Used

4. FIELDS—Horizontal perception fields
Right°_____Left°_____

5. COLOR

	Pass	Deficient	Fail
Traffic Lights			
Holmgren, Ishihara, Edrige, Nagel, or other			

6. RESPONSE TO LIGHT—
(Please furnish, if testing equipment is available)
A. Pupillary reflex R_____L_____
B. Glare resistance R_____L_____
C. Glare recovery R_____L_____

7. INJURY OR DISEASE (Please describe fully)_____
If so, what is prognosis?_____
REMARKS AND RECOMMENDATIONS_____

NAME _____
ADDRESS _____

M. D. or Opt. D.

Return this form, when completed, to examining point indicated on front.
Envelope may be sealed.

(Fig. 1)

May we emphasize at this time that all of these tests are made at infinity. None at near point.

I. ACUITY

The first test the department requires is the Acuity Test. This test is to be made at 20 feet whenever possible. If you are operating at a distance less than 20 feet, be sure to specify this information in the "Method" or "Equipment" column, directly opposite the statement, "If possible, measure acuity at 20 feet, if not, state distance." The most important thing to remember in taking the acuity is to be certain to put down the exact notation of vision. In recording the acuity, indicate it according to the 20/20 standard, rather than the decimal method as used with the Clason. The Motor Vehicle Department is using the former method.

Under Acuity, there are four different spaces to be filled in: *a.* Acuity, with and without glasses. *b.* Distance Rx. *c.* Method or equipment used. *d.* Working distance.

a. Acuity. In making this test you should first determine which eye has the poorer vision. Then take the acuity of that eye. In this way you are not conditioning the patient's reaction to give them the advantage of their good eye. You will note that there are spaces for the acuity for both eyes. When you have found the acuity, make a note of the rating in these spaces.

b. Distance Rx. All that is necessary here is to record the power of the spherical and cylindrical elements of the prescription. It is not necessary to record the axis.

c. Method or equipment used. Here you will note the name of the instrument used in taking the acuity. For instance: "Projector chart, Clason, Snellen Chart, etc."

d. Working Distance. This is written down in the "Method or Equipment Used" column, opposite the sentence "If possible, measure the acuity at 20 feet, if not, state distance." It is well to put down the working distance even though it is 20 feet.

II. EVIDENCE OF SUPPRESSION

The second test is the suppression test, both macular and perimacular. *These tests are to be made at distance,* so when using the Keystone, place the slide-holder at the position of infinity (00 far point). In making the macular suppression test the ST 2-064A Stereogram is recommended. This card consists of a double picture of a polar bear, which seen in the stereoscope appears as one picture. On one of these pictures

is a horizontal line, and on the other, in a similar position is a vertical line. Eyes that have no tendency to suppress will see these two lines as a cross. The patient's attention is directed to the cross, having him concentrate on it with both eyes open. Ask him if he sees a cross and if he sees both of the lines all of the time, or if one of the lines fades out, or if the lines alternately fade out. If the whole line or lines are disappearing, you are to note which eye or eyes are seeing the fading line or lines and record the same. At the same time, determine how long the line or lines are gone by stop watch or otherwise and record this time.

In filling in the Motor Vehicle Form there are three items to record.

a. Type of Suppression, which eye is suppressing, and suppression time. For instance: Macular suppression, right eye, two seconds.

b. Method or equipment used: Keystone, ST2-064A stereogram, Polar Bear and Cross.

c. Distance: Slide holder at 00 far point.

Peri-Macular Suppression: In checking for the peri-macular suppression on the Keystone, the familiar star and circle SU 1 PG. 16 is used. *This test is made at distance.* Placing the slide holder at the position of infinity (00 far point) insert these split slides and adjust them so that the star is in the center of the circle. This is accomplished by either moving the cards closer together (base-out) or by separating them by moving them farther apart (base-in). Having the patient concentrate on the star, ask if he sees all of the circle at all times, or whether part of the circle or all of the circle fades out. Then reverse the cards and repeat the same procedure. If the whole circle fades out you will determine the period the circle is gone by stop watch or otherwise, and record same.

a. Type of suppression and which eye is suppressing as: perimacular suppression, left eye one second, etc.

b. Method or equipment used: Keystone, star and circle SU 1 PG. 16.

c. Distance: Slide holder at 00 far point.

Gross Suppression: Checking for gross suppression on the Keystone, the dog and pig card is of value. Placing the slide holder at the *position of infinity* (00 far point) insert this card and have the patient concentrate on the pig. If he continues to see both the dog and pig at all times there is no gross suppression. However, if either the dog or the pig completely fade out there is a gross suppression. Then have the patient concentrate on the dog and repeat the same procedure. If either the dog or pig *completely* fade out or alternately fade out, determine which eye or eyes are seeing the target or targets and record. At the same

time, determine the length of time the target or targets are faded out and record this also.

In filling in the Motor Vehicle Form there are three items to record:

a. Type of suppression and which eye is suppressing, as: gross suppression, right eye 2 seconds.

b. Method or equipment used, as: Keystone, dog and pig.

c. Distance: Slide holder at 00 far point.

III. COORDINATION

A. Phorias: This test is to be made at 20 feet. Whenever operating at a distance less than this, record the exact distance at which you worked in the "Method and Equipment" column. Also, there are spaces for Exophoria, Esophoria, Right Hyperphoria, and Left Hyperphoria. Inasmuch as this test is to be made at 20 feet, it can be made on the phoropter and the method used is the "Disassociation" method.

There are the following items to record in making the notations on the Motor Vehicle form for phorias:

1. Horizontal phorias: 2 eso.

2. Method and equipment used: disassociation, phoropter and Risley prisms.

3. Working distance: 20 feet.

4. Vertical Right Hyperphoria. 2 diopters. Left Hyperphoria.

5. Method or equipment used: "Disassociation method, phoropter and Risley prisms."

6. Working distance: 20 feet.

B. Fusion: *Keystone Fusion Test*: This test is also made at distance. Use the cards DB 4 K and DB 4. They present two balls on the left side of the card, white and dark blue; and a red and light blue on the right. When fusion is adequate, the white ball on the left and the light blue on the right will fuse, the patient now seeing three balls in a vertical line, red on top, white in the center, and blue on the bottom. The DB 4 K card is equivalent to 70% fusion while the DB 4 is equivalent to 90%. To make this test, the slide holder is set for infinity or far point, or 00-00 on the rod. Place both the DB 4 K and DB 4 cards in the slide holder in such a manner that the DB 4 K card will be exposed first. Upon exposing this card, if the patient is able to fuse the four balls into three and maintain these three balls, then expose the DB 4 card. If he is able to fuse these balls also, he has the equivalent of 90% fusion, which is easily a passing mark and your test for fusion ability is complete.

However, if he was unable to fuse the balls on the DB 4 K card

which is equivalent to 70% fusion, you will, depending upon how far apart the balls were separated, determine what percentage of fusion cards to place in the card holder. Now you will have to use the split "Percentage of Fusion" cards. If the balls were separated quite a distance, start with the cards equivalent to 30% fusion to determine the amount of fusion ability the patient has. If he is able to fuse these, keep inserting cards which require greater ability to fuse until patient can no longer fuse four balls into three. Record the percentage of fusion of card on which patient is able to maintain three balls. Should he be unable to fuse 30% record as "Less than 30%."

Some of the split card sets do not have the percentage of fusion marked on them. For those of you who use these sets, the following percentage table is given:

Size of Ball	Percentage	Size of Ball	Percentage
1mm	100%	8mm	60%
2mm	90%	10mm	50%
4mm	80%	15mm	40%
6mm	70%	20mm	30%

There are again three items to be taken care of in filling out the Form: Illustration follows:

1. Fusion, 90%. (Note on the Motor Vehicle Form that it calls for excellent, good, poor, none. When using Keystone, record the percentage of fusion found. The Department will interpret the fusion as excellent, good, etc.)

2. Method or equipment used: Keystone . . . DB 4. (However, if percentage of fusion is less than 70% record as ——% split fusion cards.)

3. Working distance: 00 Far point.

C. Depth Perception: (Keystone Percentage of Stereopsis test): In this series, SM 1, each card has three horizontal lines of letters and figures of varying sizes. One of the letters or figures in each line should seem to stand out closer to the patient than any of the others. These cards are graduated to require an increasing ability to judge minute differences in depth. The examiner holds a master list of the letters or figures the patient should see standing out into space nearer to him, and as he reports these, the percentage of stereopsis can be determined.

To make this test, place the first card (SM 1 DC 1) in the card holder and direct the patient's attention to the smallest letter on the

first line that he is able to see. Then move the slide holder closer until the patient informs you that he sees this letter clearly. This is usually obtained in a pre-presbyope at -1.00 or -1.25 diopter. Then call the patient's attention to the fact that the 20/120 letter "F" in the top line is standing out closer to him than all the other letters or figures. With this introduction of what you expect the patient to do, have him tell you which letter or figure stands out closer to him in each line.

Replace one card with another until the card is reached when he is unable to name two out of three letters or figures which should stand out nearer to him. Referring to the master list, you will record the percentage of stereopsis of the card just *preceding* the one on which he missed. .

Three items must be noted in filling out the Form:

1. Percentage of stereopsis: 75%. (Note on the Motor Vehicle Form it calls for excellent, good, poor, none. When using this technique, record percentage of stereopsis found. The Department will interpret the stereopsis as excellent, good, etc.)

2. Method or equipment used: Keystone SM 1 cards.

3. Working distance: Slide holder at . . . (distance on shaft used.)

C. *Depth perception (continued)*: (Howard-Dolman Depth Perception Apparatus) (Peg Test): This apparatus consists of two pegs against a white background which must be well illuminated so that there are no shadows perceptible to the patient. The patient sees the pegs through a rectangular aperture while standing 20 feet away from the apparatus. One of the pegs is stationary while the other peg the patient can move by means of a cord. The patient is allowed five attempts to place the movable peg exactly opposite the stationary peg. The movable peg should be placed by the operator alternately in front of and back of the stationary peg at the beginning of each trial. The error is measured in millimeters on the scale on the base of the instrument. The five errors are averaged. Individuals with superior depth perception easily place the movable peg within five millimeters of the fixed peg. To make this test correctly, the patient should not be permitted to move back and forth or side to side, nor should he be permitted to juggle the peg back and forth in aligning the pegs. Also the patient should not have the lines in his hands when the examiner sets the movable peg in front of or behind the stationary peg.

Again three items must be filled out on the Form:

1. Percentage of stereopsis: 5 mm. (Here you put down the average of the patient's five tries of aligning the peg and be sure to record

the disparity in alignment of the pegs in millimeters. The Department will decide whether the patient's performance was excellent, good, etc.)

2. Method or equipment used: Howard-Dolman Depth Perception apparatus (Peg Test).

3. Distance: 20 feet.

The Motor Vehicle Department prefers the use of the Howard-Dolman Peg Test if you have the apparatus in your office; however, if you do not, they will accept the use of any other depth perception test you may use.

IV. FIELDS

Horizontal Perception Fields: To make this test requires some type of perimeter. The illumination should be 10 foot candles and the test object should be a 6mm white target. We are interested in finding at what point, temporarily, the patient is able to detect what the Motor Vehicle Department calls "mass perception." This is a *horizontal meridian* finding only. Use the 6mm white target, moving it in slowly with uniform speed (as with the regular form field) until the patient recognizes the target as *white*. He does not have to see a saturated white as in form field, merely an awareness of the white. The point at which this occurs is usually about one-half way between the motion and form fields.

This is a very important test and its purpose is to determine whether the patient has sufficient breadth of indirect vision to enable him to detect vehicles or persons approaching from the side.

The form may be filled in as follows:

1. Right 70° Left 75° (Horizontal perceptional fields).
2. Method or equipment used: Mass perception, perimeter.

V. COLORS

Any color test will be acceptable. Since the Pseudo-Isochromatic of Stilling is more generally used, we will attempt to cover it only. With this series of plates, one is able to detect very quickly any deficiencies in the perception of red-green. This test consists of 46 plates. To make the test, the plates should be held at a distance of three feet from the patient being examined, except with the comparison of colors of some of the smaller dots when the plates may be held somewhat closer. Illumination is very important as the intensity of light will alter the recognition of the plates even for those with good color sense, as the distinction of the plates varies as the figures differ in size and the shades of the dots differ in their intensity. Therefore the illumination

should be diffused daylight, not direct sunlight, coming from the back of the patient.

As a means of introducing to the patient just what you want and expect him to do, call his attention first to plates 25, 26 and 46, which are easily recognized by both the normal and color deficient individual. Thereafter, the plates may be shown in any order desired, although it is recommended that the test start with No. 1 plate.

The patient should be instructed to respond promptly and declare what he sees. Any hesitation on his part will indicate some degree of deficiency. No help should be given and when errors are made, the patient should not be informed of same.

Persons with red-green deficiency will have trouble in reading the following plates correctly, while the totally color-blind individual will rarely be able to read any of these plates: These are Nos. 1, 2, 3, 4, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 21, 22, 23, 24, 27, 28, 29, 30, 35, 36, 39, 40, 43, and 44. The book of instructions which comes with these plates covers this completely. From this, you will be able to determine if the patient is red-green deficient.

In recording the data on this test, simply record the number of plates, if any, that are missed, or note that all are correct, and the Motor Vehicle Department will then determine whether the patient has adequate color perception. Also note the type of color test used.

VI. RESPONSE TO LIGHT

A. Pupillary reflex. Direct light. To make this test, flash a light into one of the patient's eyes and note the pupillary reaction. If the pupil contracts *very* quickly, there is an excellent reflex. If it contracts *fairly* fast, there is a good reflex, if it contracts slowly, you have a fair reflex, and if it does not contract at all, the reflex is poor or nil. Repeat this same procedure for the other eye.

Filling in the Motor Vehicle Form there are two items:

1. Pupillary reflex: R Good L Good.
2. Method or equipment used: Flashing electric light.

B. Glare resistance.

C. Glare recovery.

If you have the instruments, the Motor Vehicle Department would appreciate this data. However, they realize that very few are equipped to make these tests, and while the Department is very interested in having the tests made, it is not mandatory to do so.

VII. INJURY OR DISEASE

In recording this information, describe fully and make note of any conditions you observed which would interfere with vision, such as corneal scars, cataracts, scotomas, retinal scars, hemorrhages, optic nerve atrophy, loss of an eye, etc.

This covers the Motor Vehicle Tests. We hope that all optometrists cooperate with the Motor Vehicle Department and will realize their responsibilities. Be accurate and report the exact findings. If the Department asks you for additional information regarding the applicant, please do everything you can to oblige them. Our common interests are to make the highways safe for all.

ABSTRACTS

A department in which will appear abstracts of the literature of optometry, ophthalmology and applied optics. These will be classified according to the following list although contributions to all sections will not necessarily appear in each issue.

1. Ocular Refraction.
2. Physiological Optics and Color Vision.
3. Ocular Muscles.
4. Orthoptics and Reading.
5. Anatomy, Histology and Embryology.
6. Ocular and General Pathology.
7. Ophthalmic Lenses and Material.
8. Instruments.
9. Hygiene and Illumination.
10. Applied and Physical Optics.
11. Education, Sociology and Economics.
12. Miscellaneous.

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2. PHYSIOLOGICAL OPTICS AND COLOR VISION

A PHYSIOLOGICAL UNIT OF ACCOMMODATION. J. I. Pascal. The Eye, Ear, Nose and Throat Monthly. 1946. 25. 7. 354.

Pascal points out that the unit of accommodative power in patients with ametropia is a variable and while it is expressed in terms of diopters it is not fixed as is the dioptric value of a lens. The accommodative power depends on three factors, (1) the kind of refractive error, (2) the amount of error, and (3) the distance of the correcting lens from the eye. The formula used to express this value would be $U = (1 - dL)^{-2}$, with U standing for the unit of accommodation, L for the power of the correcting lens and d the distance in meters between the second principal point of the correcting lens and the first principal point of the eye.

C. C. K.

THE MECHANICS OF ACCOMMODATION. W. H. Glazer. The Optical Journal and Review of Optometry. 1947. 84. 1. 51.

That the radial fibers of the ciliary should be under constant maxi-

mum innervation where the eye is focused for infinity fails to impress the author who briefly reviews both the Holmholtz and Tscherning theories of accommodation. He presents anatomical and physiological data which indicates to him that the Tscherning theory is the more acceptable to him of the two. He feels that accommodation is achieved through stimulation of the radial fibers via the fifth cranial nerve as a first approximation of focus and a refinement of focus takes place under a stimulus of the will via the third cranial nerve.

C. C. K.

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4. ORTHOPTICS AND READING.

WHAT IS ORTHOPTICS? W. B. Lancaster. Journal of the American Medical Association. 1946. 130. February 16, 407.

According to Lancaster, orthoptics is the art of teaching patients to use their eyes properly. The orthoptist is not concerned with strengthening extra-ocular muscles but rather directs his attention and skill to teaching the patient better ocular control and coordination.

A. V. H.

SPEED AND COMPREHENSION IN READING. M. A. Tinker. The Columbia Optometrist. 1946. 20. 79. 7.

Tinker claims that it has been experimentally established that fast readers comprehend better than slow readers. He also indicates that the fast readers *are* "fast" readers because they comprehend better than slow readers. While Tinker does not say so, it follows from the above that to improve reading skill would among other things require an improvement of the ability of the patient to think, and thus to treat a slow reader would require not only visual training but also more general education.

C. C. K.

FAVORABLE PROGNOSIS FOR MYOPIA REDUCTION. C. F. Shepard. The Optometric Weekly. 1947. 38. 3. 79-80.

Using the refractive findings of Keller, the author makes a study of these data in the effort to develop a set of criteria which would indicate a favorable prognosis for orthoptic treatment to increase the visual acuity of pseudo myopes.

This is the first of several presentations dealing with this subject resulting from a research program conducted by Shepard at the Northern Illinois College of Optometry.

C. C. K.

6. OCULAR AND GENERAL PATHOLOGY

OCULAR ANOMALIES, SERVICE INCURRED. R. B. Lopez. The Optical Journal and Review of Optometry. 1947. 84. 1. 29-32.

The author points out that many veterans will consult optometrists in the years to come. Some of these patients will have developed ocular problems which may have a service connection. He suggests a method to follow in these cases in which a complete history, ophthalmoscopic examination and the findings of the external ocular inspection are supplied to the Veterans Administration along with all refractive data and visual acuity.

Lopez also presents the classifications of cataract, conjunctivitis and keratitis as now employed by the medical staff of the Veterans Administration.

C. C. K.

GLAUCOMA. F. Janus. Transactions of the Middle East Optical Practitioners Group. Cairo, Egypt. Vol. 2. 1946.

Mentioning that glaucoma is a very old disease, known to Hippocrates as long ago as 400 B.C., Janus gives the derivation of the word as coming from the Greek "glaucos" which means sea-green, as this is the color of the pupil in absolute glaucoma.

The possibility of glaucoma being an allergic condition is discussed by the author. There is a modern school of thought which considers glaucoma to be an allergic phenomenon due to an abnormal swelling of the tissues of the eye caused by some excitant factor elsewhere in the body. Glaucoma is a condition of vascular instability, and the increase in the tension of the eye may be due either to increased secretion or to faulty drainage. Strong emotion may be a factor precipitating an attack of acute glaucoma.

The author treats the subject under three main heads:—(a) acute congestive cases; (b) sub-acute congestive cases; and (c) chronic glaucoma. The first two types are known as "uncompensated" as the eye is unable to make any attempt to overcome the symptoms.

In acute congestive glaucoma the general symptoms may be very severe apart from the local ocular symptoms. Vomiting and diarrhœa are common, and there is a case on record where a patient was treated for typhoid fever in a fever hospital for several weeks before a correct diagnosis of glaucoma was established, by which time optic atrophy had set in with permanent loss of vision. Apart from systemic symptoms, the clinical picture is very clearly marked, with severe pain in the eye,

shallow anterior chamber, muddy iris, pupillary dilation, corneal changes and large increase in tension of the eye. The treatment of an attack of acute glaucoma is by the prompt application of miotics. If drugs do not produce relief within a few hours, an immediate operation is essential if sight is to be preserved. For 8 or 10 hours the vision in the eye after operation is likely to be very poor.

Sub-acute congestive glaucoma, according to the author, is very similar except there is not the sudden loss of vision. One attack of sub-acute glaucoma will sooner or later be followed by another and eventually by an acute attack. Operation is advisable after the first attack, as this will prevent any future trouble. As soon as the effects of the attack have subsided, a filtering operation is performed, and the results are usually highly satisfactory.

Chronic glaucoma, Janus says, is one of the most difficult of all eye diseases to detect, owing to the insidious nature of its onset. There may be severe loss of the peripheral fields while the patient still retains 6/6 central vision. The disease is essentially one of middle life, usually commencing between 45-50, and of all cases seen, 70 per cent are among the female sex. Hyperopes account for about 70 per cent of cases, myopes for 20 per cent, and emmetropes and low astigmats for the remaining 10 per cent. The disease is more common among Asiatic than European races, and in Great Britain Jews are especially subject to it.

The initial symptoms may be very slight, possibly only an evening headache over one eye. The other symptom commonly met in the early stages is the phenomenon of seeing halos around lights, due to the diffraction caused by transient oedema of the cornea. Halos should always arouse suspicion of glaucoma, but in actual practice only about 10 per cent of patients reporting halos are found upon further investigation to be suffering from chronic glaucoma. The other cases are due to a low grade conjunctivitis, and in these cases repeated blinking will clear the halos.

Janus outlines the chief features in chronic glaucoma as follows:

(1) Always bilateral.
(2) No external signs, cornea clear, pupil normal, and anterior chamber is either normal or slightly deeper. Pupil sluggish and anterior chamber shallow only in late stages.
(3) Typical pathological cupping of optic disc.
(4) Glaucomatous halos.
(5) Defective dark adaptation.
(6) Increase in hypermetropia (due to ciliary cramp).

(7) Rise in tension of eye.
(8) Field defects (a) Peripheral—Ronne's step. (b) Central—Seidel's sign. Bjerrum sign.

Early cases are diagnosed by careful tonometry. The patient is hospitalized and the tension is measured carefully every four hours, day and night. The normal ocular tension varies from 18-25 millimeters of mercury, with the maximum at 3 a. m. From the results of the four-hourly tests a graph of the tension is plotted and it is easy to determine if glaucoma is present. A quicker tonometric test, although not as accurate, is to give the suspected glaucoma patient a quart of water to drink, or a large cup of black coffee. If glaucoma is present, the tension will rise immediately as much as 10-15 millimeters.

The visual acuity is no guide whatsoever, Janus claims. In examining the fields it is essential to measure both the central and peripheral fields.

The treatment generally used is by the use of miotics to keep the tension within safe limits. The patient is treated like a diabetic, and the tension is taken four-hourly while drugs are given which will prevent the tension rising above 23 millimeters of mercury. The weakest drug possible is used which will give this desired effect. Once the tension is stabilized, the patient is discharged from the hospital and continues taking the drug, while progress is watched by perimetry at regular intervals. This state of affairs may continue quite satisfactorily for many years. Unfortunately, the effect of the miotic may fail and the visual fields begin to deteriorate again. An operation is then essential.

The author points out the pathology of chronic glaucoma is unknown, but it has been shown that the drainage mechanism in the filtration angle becomes blocked by the growth of fine adhesions. The modern technique of goniometry consists of using special contact lenses which enable the surgeon to view the filtration angle and he cuts these adhesions in the filtration angle. This method, Janus explains, has been used in the United States and good results claimed, but has yet to stand the test of time.

A. V. H.

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Owner and General Manager

General Office

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Stock Room

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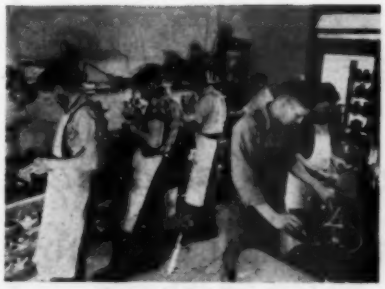

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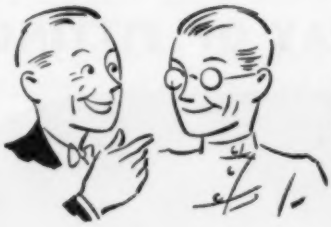

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